DOKUZ EYLÜL UNIVERSITY
GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES

DATA ANALYSIS FOR MUNICIPAL TREATMENT PLANTS IN IZMIR CITY

by
Elif Pınar ERDEN

January, 2007
İZMİR

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M.Sc THESIS EXAMINATION RESULT FORM

We have read the thesis entitled **"DATA ANALYSIS FOR MUNICIPAL TREATMENT PLANTS IN IZMIR CITY"** completed by **ELİF PINAR ERDEN** under supervision of **Prof. Dr. AYŞEGÜL PALA** and we certify that in our opinion it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Science.

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Elif Pınar ERDEN

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ABSTRACT

Izmir City has a dynamic population with a growth rate of 2.28 % according to the census in 2000 (Turkiye İstatistik Kurumu [TÜİK], 2005). By the increase of population, new municipal waste water treatment plants are been required. Therefore first of all Izmir Municipal Waste Water Treatment Plant (IMWWTP) was constructed and then Guneybatı Waste Water Treatment Plant (GWWTP) and Foca Waste Water Treatment Plant (FWWTP) were constructed to meet the increased requirements.

Planning of IMWWTP project goes back to 1969. Project had been revised several times and finally process had been changed in accordance with the feasibility report in 1996, and construction has been completed and started to operate in 2002.

GWWTP is the second plant constructed as a part of Great Channel Project. After a construction period of eight months the plant started work on 2003. Wastewater from Guzelbahce Town and wastewater from military unit located in Narlıdere region is collected and transferred to this plant.

Foca Waste Water Treatment Plant (FWWTP) and Marine Discharge Plant had been designed by Iller Bank as a part of Sewage Collection System of Foca. The required financial support had been provided by foreign credit (from Spanish Goverment). It had been constructed by Pridesa-Cevtaş Consortium and started to operate in 2004.

In this thesis, influent and effluent process data of GWWTP, IMWWTP and FWWTP were analysed and compared by using statistical analysis techniques in order to evaluate effect of pollution loads on each other and the performance of wastewater treatment plants. Samples are collected as composite. In this thesis just experimental data obtained from composite samples were used.

At the first hand, raw data had been analized and graphed to find frequencies, distribution, homogeneities, descriptive analysis values, regression and corelation by using a statistical software, SPSS (Statistical Package for the Social Sciences).

Keywords: Data analysis, statistical analysis, wastewater, biological treatment,

İZMİR İLİ EVSEL ATIKSU ARITMA TESİSLERİNİN VERİ ANALİZİ

ÖZ

Izmir Metropolu dinamik bir nüfusa sahiptir. 2000 yılı genel nüfus sayımı sonuçlarına göre yıllık % 2,238’ lik bir nüfus artış oranına sahiptir (Turkiye Devlet Istatistik Enstitusu [DIE], 2005). Artan nüfusu nedeniyle Izmir Evsel Atıksu Arıtma tesisinin kurulmasından sonra ikinci bir arıtma tesisine ihtiyaç duyulmuştur.Bu ihtiyaç ta Guneybati arıtma tesisiyle karşılanmaktadır.

İzmir Evsel Atıksu Arıtma Tesisi’nin proje başlangıcı 1969 yıllara dayanmaktadır. Proje zaman içerisinde çeşitli revizyonlardan geçirilmiş, 1996 yılında hazırlanan fizibilite raporu doğrultusunda proses değişikliğine gidilmiş, bu doğrultuda da ihale edilerek inşaat tamamlanmış ve 2001 yılı başında ise işletmeye alınmıştır.

Guneybati Atıksu Arıtma Tesisi, Izmir Büyük Kanal projesi kapsamında inşa edilen 2. tesistir. İnşaatı 8 ayda tamamlanmış ve 2003 yılında da işletmeye alınmıştır. Tesise Guzelbahce ilçesinin ve Narlıdere Askeri alanından toplanan atıksular gelmektedir

Foca Atıksu Arıtma ve Deniz Deşarjları Tesisleri, İller Bankası tarafından yaptırılan kanalizasyon projesinin bir parçası olarak tasarlanmıştır. Finansmanının tamamı dış kredi (İspanyol Hükümeti) ile sağlanmış. Pridesa-Çevtaş Konsorsiyumu tarafından inşa edilerek 2004 yılında işletmeye alınmıştır.

Bu çalışmada, İzmir, Guneybati ve Foca Atıksu Arıtma Tesisleri’ nin giriş ve çıkış ünitelerinden alınan numunelerden elde edilen proses verileri, kirlilik yuklerinin birbirlerine etkisi ve bu yuklerin tesislerin performanslarına etkilerinin değerlendirilmesi amacıyla, istatistiksel analiz teknikleri kullanılarak karşılaştırılmıştır.Ornekler komposite olarak toplanmış ve bu orneklerden deneylere dayalı veriler elde edilmiştir.

İlk olarak ham verilerin frekanslarının, dağılımlarının, homojenliklerinin, tanımlayıcı istatistiklerinin, regresyon ve korelasyon değerlerının bulunması için SPSS (Sosyal Bilimler için İstatistiksel Paket) programi ile analizleri yapılarak grafikleri çıkarılmıştır.

Anahtar kelimeler: Veri analizi,istatistiksel analiz, atıksu, biyolojik arıtma

CONTENTS

CHAPTER ONE
INTRODUCTION

1.1 Introduction

Since the operation of Wastewater Treatment Plants (WWTP's) are highly variable and dynamic, data analysis give certain advantages such as understanding of process and controlling of operational errors. Effluent data may be affected from different conditions such as weather conditions, microorganism structure and waste water character. In this thesis, three WWTP's of Izmir are studied and compared by using statistical analysis techniques in order to evaluate the performance of treatment plants. A statistical software (SPSS) is used for data analysis.

Influent and Effluent BOD_5 (Biological Oxygen Demand, mg/l), COD (Chemical Oxygen Demand, mg/l), SS (suspended solid, mg/l) , TP(Total Phosphorus, mg/l), TN (Total Nitrogen, mg/l) concentrations were used as data to evaluate the pollution loads of wastewater by using the average daily flow (m^3/day) values. Furthermore pollution loads calculated as $QBOD_5$ (kg/day), QCOD (kg/day), QSS (kg/day), QTP (kg/day), and QTN (kg/day) with related flow were also analyzed and compared each other in order to investigate the relations and effects of loads on wastewater treatment efficiency. Influent and effluent conductivity (μs/cm) and, salinity (%o) data were also evaluated.

Izmir Waste Water Treatment Plant (IWWTP) was constructed in the scope of the Great Channel Project in order to prevent Izmir Bay from water pollution. IWWTP has been designed to treat of 7 m^3/s dry weather flow and a peak flow of 12 m^3/s. IWWTP is based on an advanced biological process for the removal carbon, nitrogen and phosphorus. The first unit of the preliminary treatment comprises the fine screens. The preliminary treatment station consists of two double aerated grit chambers. Three parshall channel are used to measure the flow. Aerated grit chambers provide a period of wastewater detention for the purpose trapping grit through the use of an air induced rotation of the wastewater. Effluent from the grit channels passes through 3-parallel running Parshall flumes for flow measurement.

After passing the three Parshall flumes, the wastewater flows to distribution chamber. Primary sedimentation tanks each of 40m tank diameter remove the settle able and floatable solids from the wastewater for appropriate handling . The effluent from pretreatment units goes to biophosphorus tanks which are six pieces and 90 m length with a total volume of 49200 m^3. The tanks are operated in series; the effluent of the second tank is distributed to two aeration tank lines. After that, the wastewater flows to the oxidation tanks. In three phase totally 12 oxidation tanks are presented. At IMWWT a cascade of two aeration tanks represents one series of aeration tank. Volume of each tank is 26500 m^3 and overall length of each tank is 155 m. At the end, 12 pieces final sedimentation tanks each of 60 m tank diameter are located to separate activated sludge from effluent. Treated wastewater from final sedimentation tanks is discharged into the sea through a discharge channel. Sludge removal system including Sludge Holding and Sludge Dewatering Plant is also existed at IMWWTP. In Figure 1.1, IMWWTP Flow Diagram is given.

Guneybatı Waste Water Treatment Plant (GWWTP) is second treatment plant constructed in the scope of the Great Channel Project at the southwestern part of the Izmir City. Guneybatı Waste Water Treatment Plant has been designed and constructed to treat an average wastewater flow of 0.25 m^3/s. It is also an advanced biological treatment plant for carbon, nitrogen and phosphorus removal. Guneybatı WWTP consists of pre-treatment units , two pieces biophosphorus tanks with 24.60 m length and a total volume of 2700 m^3, two oxidation tanks with a 54.30m length and total volume of 10042 m^3, two final sedimentation tanks each of 28 m tank diameter. Treated water from the final settling tanks is discharged into the sea by 600 m long discharge channel. GWWTP Flow Diagram is given in Figure1.2.

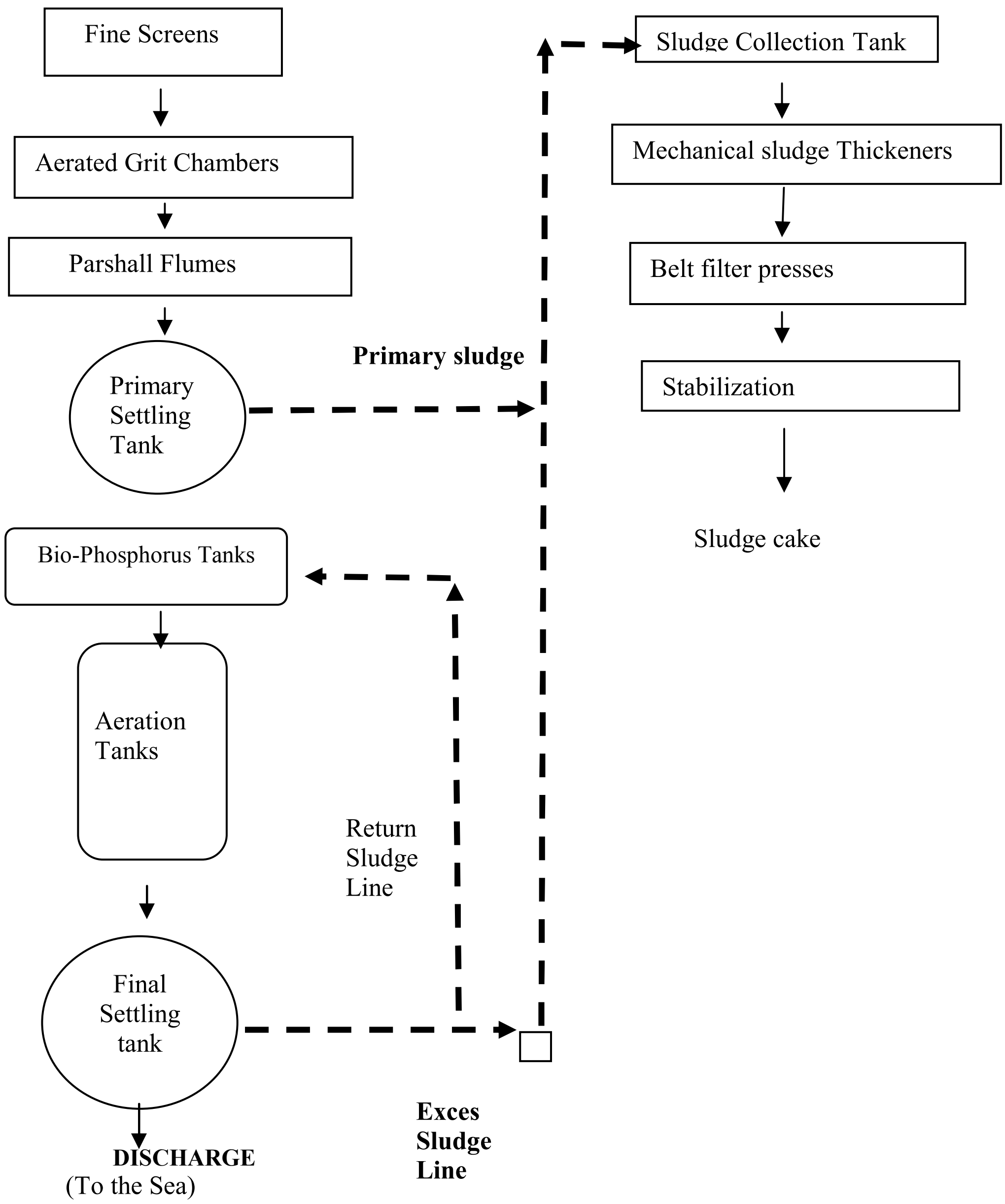


Figure 1.1IMWWTP flow diagram

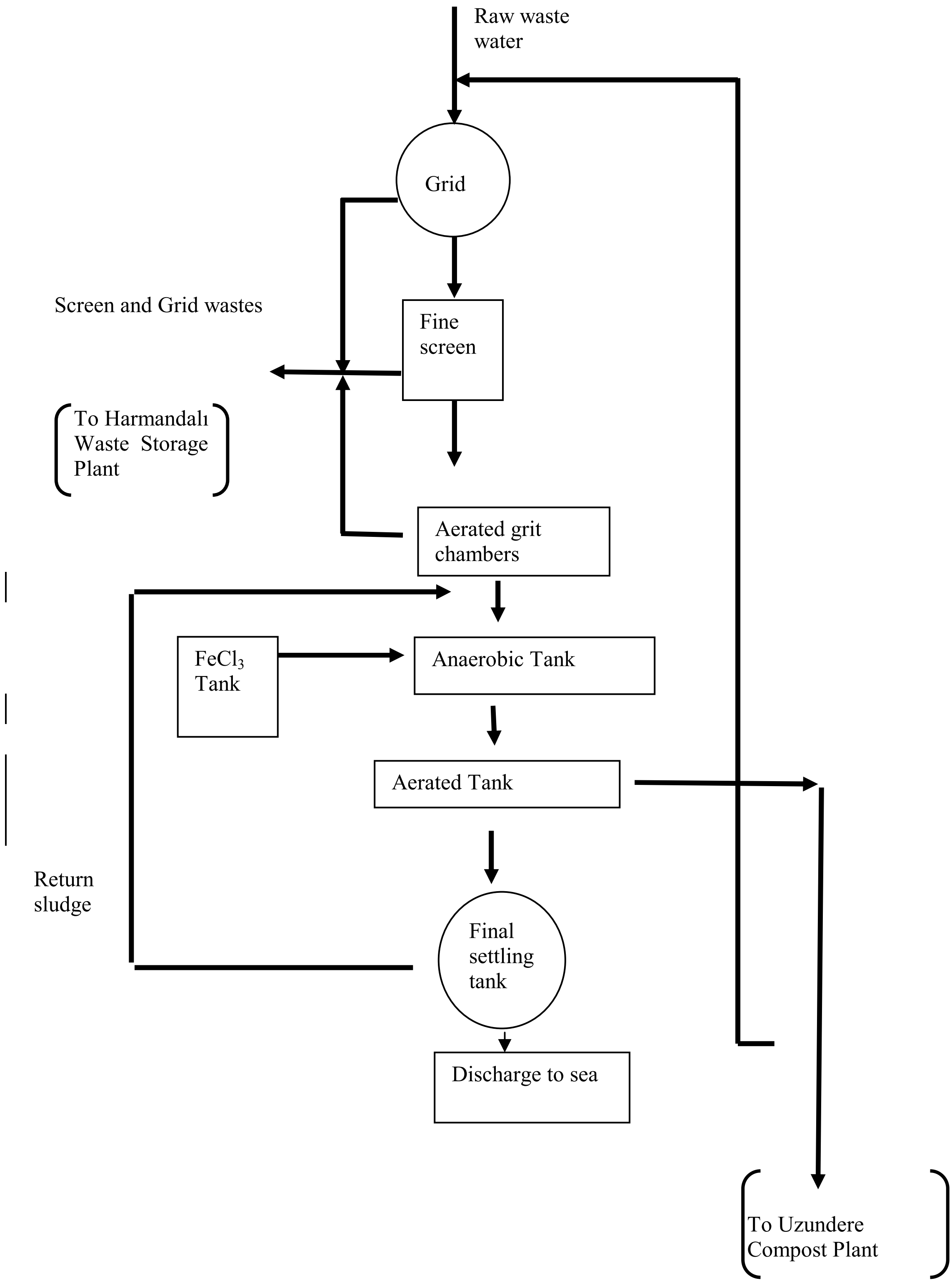


Figure 1.2 GWWTP flow diagram

FWWTP is constructed in the scope of the Foca Sewage Collection System Project. FWWTP has been designed and constructed to treat 0,16 m^3/s waste water. It consists a pre-treatment unit with fine screen, grid removal and 2 primary sedimentation tanks of 16 m diameter, 1 anaerobic tank with a 11.90 m length and 708.05 m^3 volume, 2 biologic reactor (anoxic and oxic) with 40.90 m length and 2934 m^3 volume, 2 final sedimentation tanks of 21 m diameter , 1 sludge thickener unit of 11 m diameter, and sludge dewatering unit. Treated water is discharged into the sea by a 3922 m long discharge channel. FWWTP Flow Diagram is given in Figure1.3.

The purpose of this project is to analyse influent and effluent data of three waste water treatment plants by using the statistical methods, in order to compare each variable of influent and effluent of waste water treatment plants. In this thesis, three biologic waste water treatment plants which have similar processes are investigated. The performance of the WWTP's are evaluated by using statistical data analysis techniques.

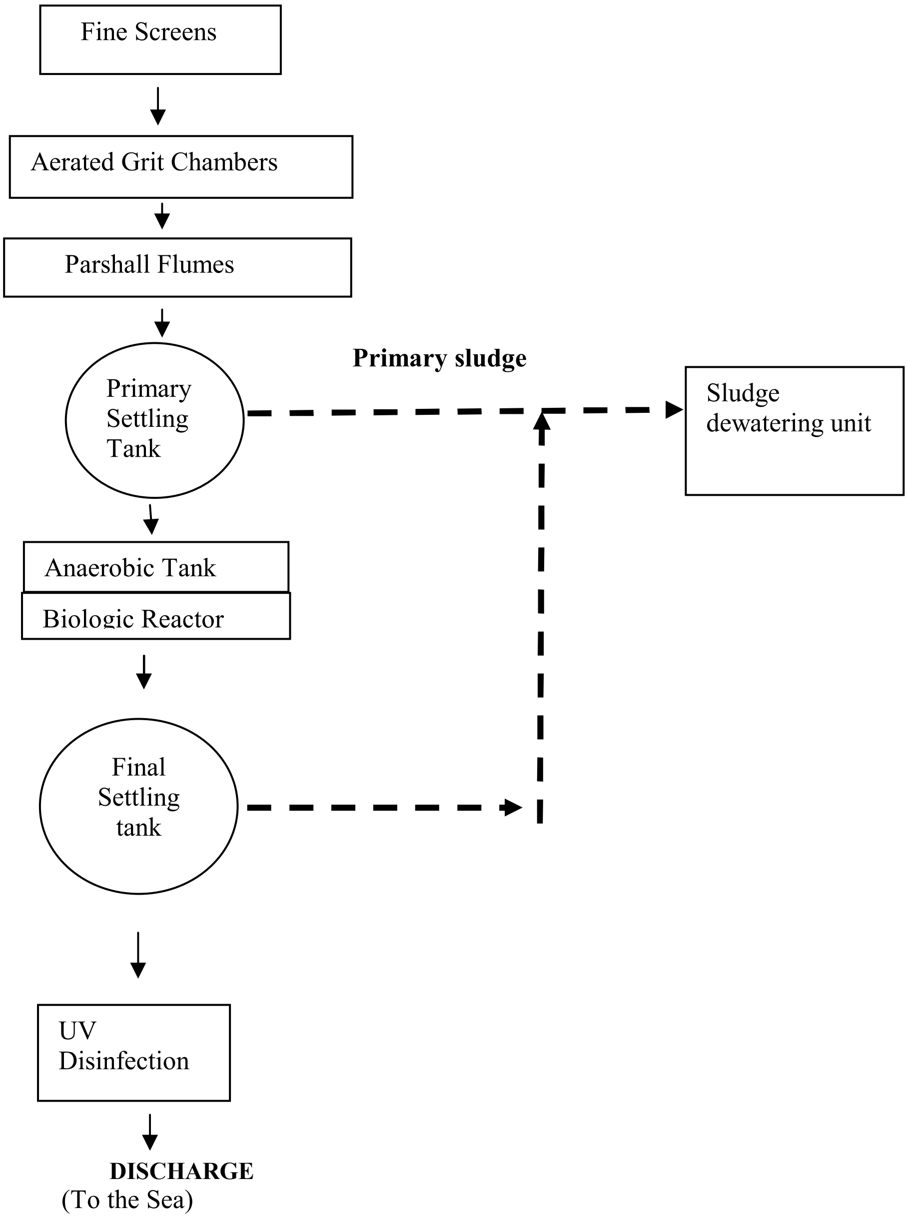


Figure 1.3 FWWTP flow diagram

CHAPTER TWO
MATERIAL AND METHODS

2.1 Data

Wastewater Treatment Plant's data were obtained from average concentrations of wwtp's influent and effluent samples. Wastewater samples are collected daily from the influent and effluent as composite samples 24 hours.

Influent and Effluent BOD_5 (Biological Oxygen Demand, mg/l), COD (Chemical Oxygen Demand, mg/l), SS (suspended solid, mg/l), TP (Total Phosphorus, mg/l), TN (Total Nitrogen, mg/l) concentrations were used as data to evaluate the pollution loads of wastewater by using the average daily flow (m^3/day) values. Furthermore pollution loads calculated as $QBOD_5$ (kg/day), QCOD (kg/day), QSS (kg/day), QTP (kg/day), and QTN (kg/day) with related flow were also analyzed and compared each other in order to investigate the relations and effects of loads on wastewater treatment efficiency. Influent and effluent conductivity (µs/cm) and, salinity (%o) data were also evaluated

2.2 Data Analysis

In Data Analysis, each WWTP's influent and effluent data was analyzed. Frequency analysis, histogram graphics, descriptive statistics, homogeneity analysis, correlation and regression analysis, scatter graphics, boxplot graphics were applied to data. Furthermore, variance analysis (ANOVA) was applied to compare the WWTP's influent and effluent data in order to evaluate treatment efficiency performances

A software system, SPSS ("Statistical Package for the Social Sciences") is used for data management and analysis. 1247 data and 12 pollution loads(BOD_5 (Biological Oxygen Demand, mg/l), COD (Chemical Oxygen Demand, mg/l), SS (suspended solid, mg/l) , TP(Total Phosphorus, mg/l), TN (Total Nitrogen, mg/l), Conductivity (µs/cm), Salinity (%), Flow (m^3/day), $QBOD_5$ (kg/day), QCOD (kg/day), QTP (kg/day), and QTN (kg/day) of IMWWTP, 1035 data and 10 pollution loads(BOD_5 (Biological Oxygen Demand, mg/l), COD (Chemical Oxygen Demand, mg/l), SS (suspended solid, mg/l) , TP(Total Phosphorus, mg/l), TN (Total Nitrogen, mg/l), Flow (m^3/day), $QBOD_5$ (kg/day), QCOD (kg/day), QTP (kg/day), and QTN (kg/day)) of GWWTP and 625 data and 10 pollution loads(BOD_5 (Biological Oxygen Demand, mg/l), COD (Chemical Oxygen Demand, mg/l), SS (suspended solid, mg/l), TP(Total Phosphorus, mg/l), TN (Total Nitrogen, mg/l), Flow (m^3/day), $QBOD_5$ (kg/day), QCOD (kg/day), QTP (kg/day), and QTN (kg/day) of FWWTP are analyzed in the thesis study.

A frequency table is a way of summarising a set of data. It is a record of how often each value (or set of values) of the variable in question occurs (Easton, & McColl, 1997). At the beginning of data analysis, preperation of the frequency table and determination of descriptive statistics of data are introduced. The histogram graphics shows us the scope of the frequency distribution and the range of values; it also impresses central tendency and shows symmetry or lack of it(Berthouex, & Brown*)*. Frequency distribution, mean value, standart deviation and number of data can be obtained from histogram. If description table and the coefficients of skewness and kurtosis are used together, it is easier to comment the histogram. Skewness and kurtosis display the way of tendency of series on the histogram graphic. When skewness get away from "0" , the curve tail turns towards to right on histogram graphic. Kurtosis displays the flatness of series. When the series are normal distributed, kurtosis coefficients are "3"; if kurtosis coefficient is greater than "3", shape of the graphic is flat, else it has sharp top. The purpose of homogeneity analysis is to find quantifications that are optimal in the sense, where the categories are separated from each other as much as possible. This implies that objects in the same category are plotted close to each other and objects in different categories are plotted as far as possible. In this way, the categories are divided the objects into homogeneous subgroups. Variables are considered as homogeneous when they classify objects in the same categories into the same subgroups (http://www1.uni-hamburg.de/RRZ/Software/SPSS). With correlation analysis variables are analyzed and the linear relationship is searched between them. The scatter and box plot graphics are also prepared for to obtain normality and distribution of data. The scatter graphics are shown us linear relation on graphics clearly.

Regression analysis is a statistical method for the investigation of relationships between variables (Sykes, 1987). With the regression analysis, the model is constituted towards proving regression analysis results

With the variance analysis, influent and effluent values of three waste water treatment plants are analysed and compared. The first step, the statistical model is established whether or not the variable of treatment plants have the same or differing means. The second step, observed result are commented that tests whether or not groups of data have the same or differing means

CHAPTER THREE
RESULTS AND DISCUSSION

3.1 Data frequency analysis and descriptive statistics of IMWWTP

At the beginning of data analysis, data should be checked whether it has a normal distribution or not. Therefore the common methods, frequency tables and histograms are prepeared in the first step of this thesis, but data distribution could not be observed clearly in this way, so the descriptive statistical tables are determined for all raw data of IMWWTP in order to get a clear observation of normal distribution by checking the skewness and kurtosis coefficients.

Table 3.1 Mean, median and mode values of IMWWTP's influent data

	COD mg/l	BOD mg/l	SS mg/l	TP mg/l	TN mg/l	NH_4-N mg/l	QCOD kg/day	QTN kg/day	QTP kg/day	QBOD kg/day
Mean	415	209	216	7.90	36.67	23.52	226631	20266.3	4300.17	115179
Median	418	200	204	7.90	36	22.2	221805	19993	4305.5	109299
Mode	450	200	172	8.60	40	15.00	208278	21560	2901.6	92640

By the use of descriptive statistic methods, for 1247 values of IMWWTP's daily influent data. It is seen that when there is a normal distribution, mean, median and mode values would be equal. According to Table 3.1, values are close to each other but there is also skewness. If mean > median > mode ,there is a skewness to right on histogram graphics. If the opposite of it , skewness is to left side. (www.tip.erciyes.edu.tr/Anabilim/dahili/Web/halk_sagligi/dersler/tanimlayici_olculer.ppt#305,10,SINIFLANDIRILMIS VERILERDE HESAPLAMA). BOD, SS, NH_4N, QCOD, QTN, QTP, QBOD's' skewness is to right on histogram graphics. COD, TP, TN's skewness are to left on histogram graphics.

Table 3.2 Mean, median and mode values of IMWWTP's effluent data

	COD mg/l	BOD mg/l	SS mg/l	TP mg/l	TN mg/l	NH_4-N mg/l	QCOD kg/day	QTN kg/day	QTP kg/day	QBOD kg/day
Mean	55	21	24	4	11	3	30474	6038	2480	11763
Median	52	17	22	5	10	2	28185	5398	2524	9461
Mode	25	10	12	5	9	0.1	13446	4822	2318	1414

For the IMWWTP's effluent data analysis, normal distribution is not observed for COD, BOD_5, SS and NH_4-N data given in Table 3.2. Because mode values are considerably far from mean and median values. COD, BOD_5, SS, TN, NH_4-N, QCOD, QTN, QTP and $QBOD_5$'s skew ness are to right on histogram graphics.

Descriptive statistics are given Table 3.3 for 1247 values of IMWWTP's daily influent data. Maximum and minimum values are found respectively 986 mg/l, 16.10 mg/l for COD; 580mg/l, 20 mg/l for BOD5; 735.20mg/l, 22.40mg/l for SS; 27.64mg/l, 1.40 mg/l for TP; 97.48 mg/l, 3.83 mg/l for TN; 56.06 mg/l, 2.07 mg/l for NH_4-N; 614640 kg/day, 9322 kg/day for QCOD; 57978.47 kg/day, 1121.29 kg/day for QTN; 9877.98 kg/day, 211.80 kg/day for QTP; 307119 kg/day, 19005 kg/day for $QBOD_5$, 13830 µs/cm, 1158 µs/cm for Conductivity, 8.2%, 3% for Salinity, 941000 m^3/day, 50963 m^3/day for Flow.

As it is shown in Table 3.4, for 1247 values of IMWWTP's daily effluent data, maximum and minimum values are found respectively 142 mg/l, 4.84 mg/l for COD; 120mg/l, 5 mg/l for BOD5; 79.2mg/l, 1.66mg/l for SS; 15.78mg/l, 0.21 mg/l for TP; 26.6 mg/l, 1.1 mg/l for TN; 7.3 mg/l, 1.5 mg/l for NH_4-N; 96216 kg/day, 2180 kg/day for QCOD; 17332 kg/day, 606 kg/day for QTN; 9461 kg/day, 130 kg/day for QTP; 37822 kg/day, 764 kg/day for $QBOD_5$, 11900 µs/cm, 2530 µs/cm for Conductivity, 7.3 %, 1.5 % for Salinity, 941000 m^3/day, 50963 m^3/day . Normal distribution does not observe for IMWWTP's effluent values, because mean, median and mode are not equal according to Table 3.4

Table 3.3 Influent data frequency analysis and descriptive statistics of IMWWTP

Statistics

		COD mg/l	BOD mg/l	SS mg/l	TP mg/l	TN mg/l	CONDUCTIVITY µs/cm	SALINITY %	NH4N mg/l	FLOW m³/day	QCOD kg/day	QTN kg/day	QTP kg/day	QBOD kg/day
N	Valid	1081	833	1094	1034	993	1003	997	946	1247	947	993	1024	687
	Missing	166	414	153	213	254	244	250	301	0	300	254	223	560
Mean		415.15	209.68	216.16	7.91	36.67	7510.22	4.35	23.52	540494.21	226631.24	20100.70	4235.20	115179.25
Std. Error of Mean		4.58	2.87	2.80	.07	.33	59.44	.03	.28	2595.86	2925.54	207.63	37.41	1699.56
Median		418.00	200.00	204.00	7.90	36.00	7490.00	4.30	22.20	540972.00	221805.00	19928.40	4305.65	109299.00
Mode		450.00	200.00	172.00[a]	8.60	40.00	6000.00	4.00	15.00[a]	579000.00	208278.00	21560.00	2901.60	92640.00[a]
Std. Deviation		150.43	82.80	92.71	2.32	10.39	1882.48	1.10	8.48	91667.40	90028.74	6542.75	1197.22	44546.68
Variance		22629.52	6855.22	8595.30	5.38	107.89	3543730.58	1.22	71.99	8402912055.13	8105173202.01	42807621.71	1433345.84	1984406852.38
Skewness		.48	1.10	1.37	1.53	1.21	.03	-.11	.89	-1.00	.66	1.00	-.06	.93
Std. Error of Skewness		.07	.08	.07	.08	.08	.08	.08	.08	.07	.08	.08	.08	.09
Kurtosis		.93	1.75	3.81	10.00	4.84	.26	.69	1.63	4.92	1.23	4.16	1.02	1.59
Std. Error of Kurtosis		.15	.17	.15	.15	.16	.15	.15	.16	.14	.16	.16	.15	.19
Range		969.90	560.00	712.80	26.24	93.65	12272.00	7.90	53.99	890037.00	605318.00	56857.18	9666.18	288114.00
Minimum		16.10	20.00	22.40	1.40	3.83	1558.00	.30	2.07	50963.00	9322.00	1121.29	211.80	19005.00
Maximum		986.00	580.00	735.20	27.64	97.48	13830.00	8.20	56.06	941000.00	614640.00	57978.47	9877.98	307119.00
Sum		448771.75	174665.00	236479.52	8183.77	36414.60	7532748.00	4331.99	22253.36	673996281.00	214619782.00	19959996.02	4336842.40	79128142.00
Percentiles	10	226.00	120.00	116.00	5.24	25.24	5222.00	3.00	14.10	458000.00	118704.60	12825.86	2724.75	65490.20
	20	285.40	140.00	143.60	6.20	28.80	5938.00	3.50	17.48	495155.80	152186.20	15760.20	3309.74	80441.60
	25	309.00	160.00	154.30	6.56	30.26	6230.00	3.60	18.46	504522.00	168203.00	16688.10	3543.19	85120.00
	30	332.60	160.00	164.40	6.93	31.45	6500.00	3.80	19.50	513752.00	179207.40	17288.55	3718.16	90734.20
	40	382.00	180.00	185.20	7.44	33.89	7000.00	4.10	21.13	528600.00	201146.80	18764.56	4064.86	99603.20
	50	418.00	200.00	204.00	7.90	36.00	7490.00	4.30	22.20	540972.00	221805.00	19928.40	4305.65	109299.00
	60	451.00	220.00	227.20	8.42	38.46	8000.00	4.60	24.00	558602.00	240796.40	20998.61	4548.41	118824.80
	70	480.00	240.00	250.00	8.80	40.59	8490.00	4.90	26.10	579000.00	261072.20	22179.82	4785.69	130849.80
	75	502.00	240.00	263.00	9.10	42.00	8740.00	5.10	27.36	589078.00	276293.00	22775.77	4916.85	139130.00
	80	523.00	260.00	274.00	9.40	43.00	9000.00	5.20	29.02	603357.60	290971.80	23734.31	5106.27	145200.00
	90	597.60	320.00	316.00	10.28	47.92	9969.20	5.70	34.13	631859.20	335190.40	27102.71	5645.80	169140.80

a. Multiple modes exist. The smallest value is shown

Table 3.4 Effluent data frequency analysis and descriptive statistics of IMWWTP

Statistics

		COD mg/l	BOD mg/l	SS mg/l	TP mg/l	TN mg/l	CONDUCTIVITY µs/cm	SALINITY %	NH4N mg/l	FLOW m³/day	QCOD kg/day	QTN kg/day	QTP kg/day	QBOD kg/day
N	Valid	863	607	982	845	768	985	953	950	1247	859	767	844	593
	Missing	384	640	265	402	479	262	294	297	0	388	480	403	654
Mean		55.34	22.84	24.82	4.49	10.63	7067.23	4.09	2.79	540494.21	30473.77	6038.13	2479.99	11755.18
Std. Error of Mean		.87	.71	.48	.06	.16	54.40	.03	.09	2595.86	527.68	108.45	35.59	340.48
Median		52.00	19.00	22.00	4.60	9.75	7060.00	4.10	2.01	540972.00	28185.00	5398.00	2523.50	9432.00
Mode		25.00[a]	10.00	12.00	5.20	8.60	7000.00	4.00	.10	579000.00	13446.00[a]	4822.00[a]	2318.00[a]	1414.00[a]
Std. Deviation		25.51	17.44	15.14	1.70	4.52	1707.39	.97	2.66	91667.40	15465.53	3003.63	1034.05	8291.14
Variance		650.55	304.16	229.14	2.89	20.42	2915186.80	.95	7.10	8.40E+009	239182538	9021792.58	1069263.69	68742920
Skewness		.76	2.01	.98	.29	.80	.02	.06	1.49	-1.00	.82	.81	.63	1.04
Std. Error of Skewness		.08	.10	.08	.08	.09	.08	.08	.08	.07	.08	.09	.08	.10
Kurtosis		.41	6.09	.74	3.00	.24	-.24	-.18	1.88	4.92	.53	.20	3.86	.20
Std. Error of Kurtosis		.17	.20	.16	.17	.18	.16	.16	.16	.14	.17	.18	.17	.20
Range		137.16	115.00	77.54	15.57	25.50	9370.00	5.80	13.32	890037.00	94036.00	16726.00	9331.00	37058.00
Minimum		4.84	5.00	1.66	.21	1.10	2530.00	1.50	.03	50963.00	2180.00	606.00	130.00	764.00
Maximum		142.00	120.00	79.20	15.78	26.60	11900.00	7.30	13.35	941000.00	96216.00	17332.00	9461.00	37822.00
Sum		47760.20	13864.00	24372.90	3793.63	8167.30	6961224.00	3898.00	2646.15	673996281	26176972	4631243.00	2093112.00	6970819.00
Percentiles	10	25.00	5.00	8.00	2.37	5.60	4936.00	2.90	.27	458000.00	12374.00	2829.60	1134.50	2881.20
	20	33.00	10.00	12.00	3.23	6.60	5590.00	3.20	.60	495155.80	17313.00	3405.60	1677.00	5044.00
	25	37.00	10.00	13.10	3.52	7.13	5960.00	3.40	.81	504522.00	18952.00	3680.00	1928.50	5414.50
	30	40.00	10.00	15.00	3.80	7.60	6090.00	3.50	1.00	513752.00	20858.00	3936.80	2055.00	5857.20
	40	45.60	15.00	18.80	4.30	8.60	6730.00	3.80	1.50	528600.00	24036.00	4602.20	2329.00	7584.80
	50	52.00	19.00	22.00	4.60	9.75	7060.00	4.10	2.01	540972.00	28185.00	5398.00	2523.50	9432.00
	60	58.00	20.00	25.76	4.93	11.10	7472.00	4.30	2.49	558602.00	31900.00	6261.40	2698.00	11167.60
	70	65.00	25.00	30.00	5.27	12.50	8000.00	4.60	3.20	579000.00	36806.00	7291.80	2943.00	13739.40
	75	70.00	30.00	33.00	5.40	13.20	8275.00	4.80	3.73	589078.00	39429.00	7885.00	3047.00	15396.00
	80	76.38	35.00	36.62	5.66	14.30	8510.00	5.00	4.58	603357.60	42742.00	8729.20	3203.00	18592.20
	90	90.00	45.00	46.00	6.38	17.31	9244.00	5.30	6.88	631859.20	51856.00	10486.80	3614.50	25460.60

a. Multiple modes exist. The smallest value is shown

Whether data distribution deviates from normality to right or left on histogram are obtain also by skewness and kurtosis coefficient. The skewness cofficients which are close to “0” give us a normal distribution. To observe the normality of data; mode, median and mean values are inspected whether they are equal or very closer to each other beforehand

In Table 3.3 skewness values for influent data are given as 0.48 mg/l for COD, 1.101 mg/l for BOD, 1.37 mg/l for SS, 1.53 mg/l for TP, 1.212 mg/l for TN, 0.66kg/day for QCOD, 1.0 kg/day for QTN, -0.06 kg/day for QTP, 0.93 kg/day for QBOD. In Table2.4, skewness values for effluent data are given as 0.763 mg/l, 2.01 mg/l, 0.97 mg/l, 0.291 mg/l, 0.798 mg/l, 0.015µs/cm, 0.059 %, 1.48 mg/l, 0.82 kg/day, 0.81 kg/day, 0.63 kg/day, 1.036 kg/day respectively for COD, BOD, SS, TP, TN, Conductivity, Salinity, NH4N, QTN, QCOD, QTP, QBOD. As for IMWWTP’ s influent data, COD, BOD, SS, TP, TN skewness values are diverged from “0” ,which means, these values are skewed to right on histogram. There are percentile rows at the end of Table 3.3 and Table 3.4. In these rows total numbers of values for each influent or effluent data are divided to ten and given by percentiles, and the quantities in the corresponding column give us, how much quantity of the influent or effluent data is under the given percentile. The values of influent data which cover 90% of total are 596.8 mg/l for COD, 315.63 mg/l for BOD, 316.12 mg/l for SS, 10.27 mg/g for TP, 47.82 mg/l for TN, 34.09 mg/l for NH4N, 631659 m3/day for FLOW, 335013.8 kg/day for QCOD, 27073 kg/day QTN, 5643 kg/day for QTP, 169065.8 kg/day for QBOD, and the values for effluent data which cover 90% of total are 90.21 mg/l for COD, 45.55 mg/ for BOD, 46.23 mg/l for SS, 6.36mg/l for TP, 17.28 mg/l for TN, 6.88 mg/l for NH4N, 631659 m3/day for FLOW, 51808 kg/day for QCOD, 10476 kg/day QTN, 3610 kg/day for QTP, 25436.2 kg/day for QBOD.

3.2 Histogram of IMWWTP data

In this part, frequency tables are used to explain the histogram. According to Figure 3.3, IMWWTP’s influent data of BOD have a low frequency distribution between 500-580 mg/l. Data repeated just for 5 times between these values which gives below 1 % in the percentile row. This specific interval caused a deviation from normal distribution. IMWWTP' s influent data of SS have a low frequency distribution between 600-735 mg/l in Figure 3.5 and data repeated 3 times between these values which gives below 1 % in the percentile row. TP frequency of IMWWTP influent data have low frequency distribution between 20-30 mg/l in Figure 3.7 and data repeated 3 times between these values which gives 2 % in the percentile row. Data repeated 6 times between 80-100 mg/l for TN and these values which gives below 1 % in the percentile row. QCOD have a low frequency distribution between 500000-600000 kg/day in Figure 3.17 and data repeated 5 times between these values which gives 1 % in the percentile row. QTN frequency of IMWWTP influent data have low frequency distribution between 40000-50000 kg/day in Figure 3.19 that repeated 13 times between these values which gives 1.5 % in the percentile row. QTP frequency of IMWWTP influent data have low value between 9000-15000 kg/day in Figure 3.21, data repeated 6 times between these values which gives 1 % in the percentile row.

According to Figure 3.4, BOD of IMWWTP's effluent data have low frequency distribution between 80-120 mg/l. Data were repeated 10 times between these values which gives 1 % in the percentile row. TP frequency of IMWWTP effluent data have low value between 10-15.78 mg/l in Figure 3.8 that repeated 4 times between these values which gives 1 % in the percentile row. NH_4N frequency of IMWWTP effluent data have low value between 12-13.35 mg/l in Figure 3.16 that repeated 8 times between these values which gives 1 % in the percentile row. Frequency is 4 for TN between 25-30 mg/l and the percentage is under the 1 %. QCOD frequency of IMWWTP influent data have low value between 80000-100000 kg/day in Figure 3.18 that repeated 3 times and percentage of data under 1%. Frequency is 4 for QTN between 15000-17332 mg/l, the percentage is under 1% (Figure 3.20). QTP frequency of IMWWTP effluent data have low value between 6000-10000 mg/l in Figure 3.22 that repeated 4 times and percentage of data under 1 %. QBOD frequency of IMWWTP effluent data have low value between 6000-10000 mg/l in Figure 3.22 that repeated 4 times and percentage of data under 1 %.

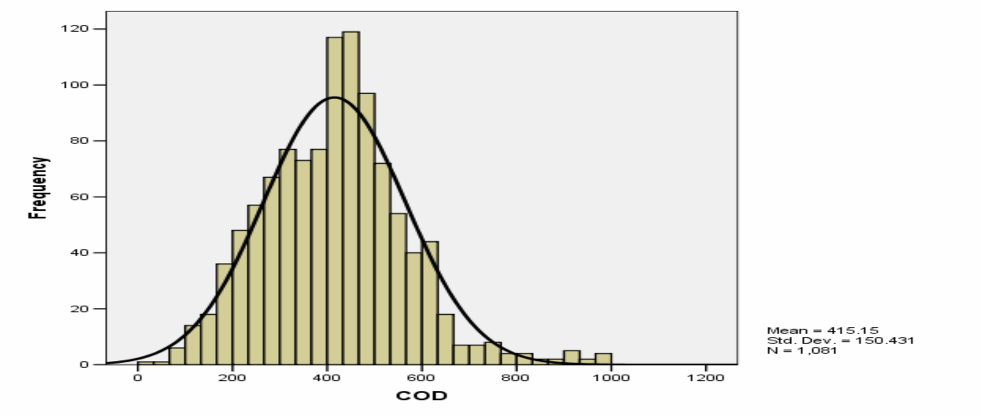


Figure 3.1 IMWWTP frequency graphic of COD in influent data

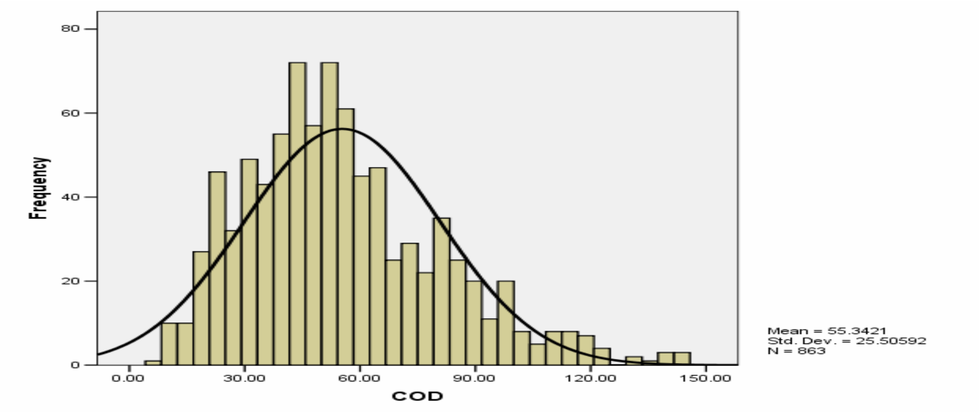


Figure 3.2 IMWWTP frequency graphic of COD in effluent data

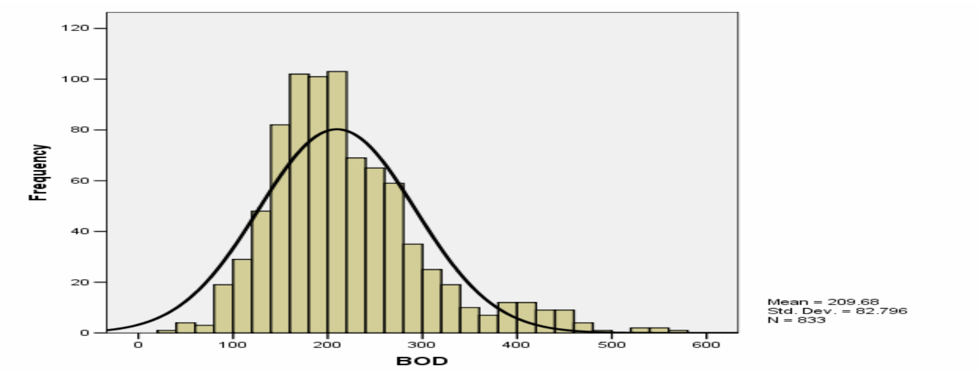
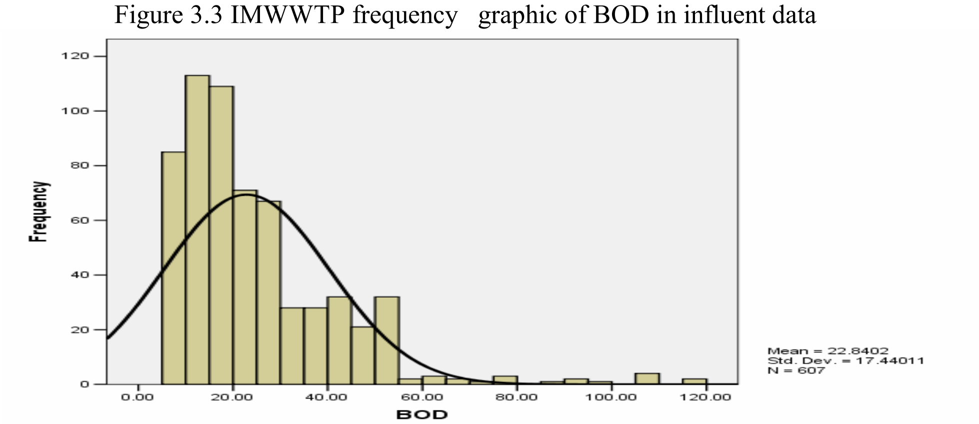


Figure 3.3 IMWWTP frequency graphic of BOD in influent data



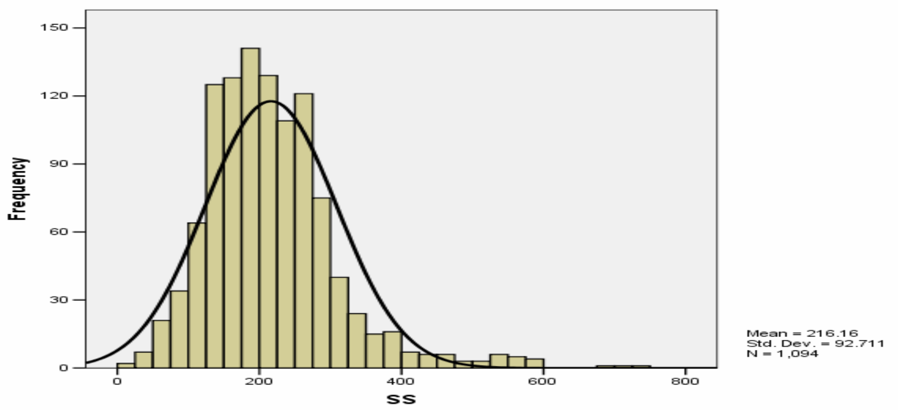


Figure 3.5 IMWWTP frequency graphic of SS in influent data

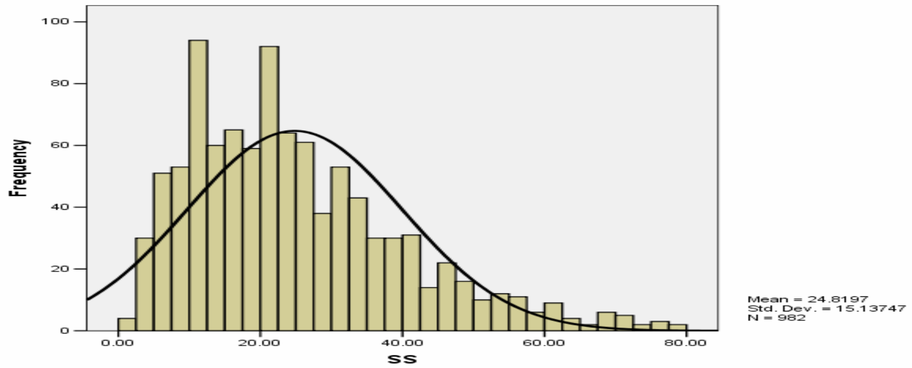


Figure 3.6 IMWWTP frequency graphic of SS in effluent data

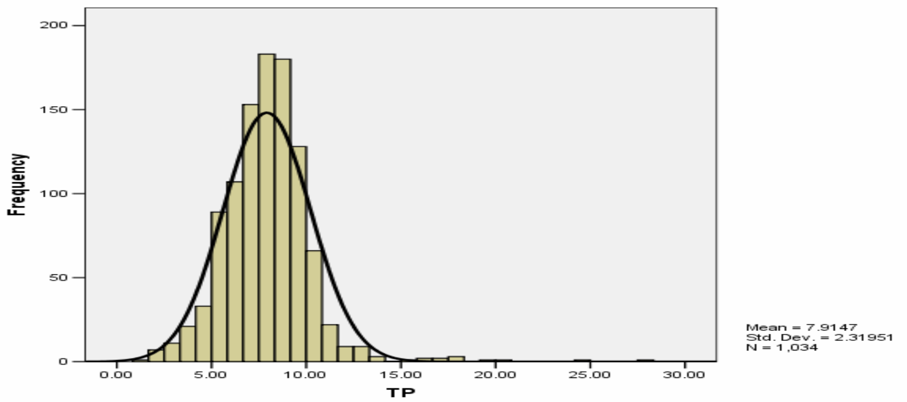


Figure 3.7 IMWWTP frequency graphic of TP in influent data

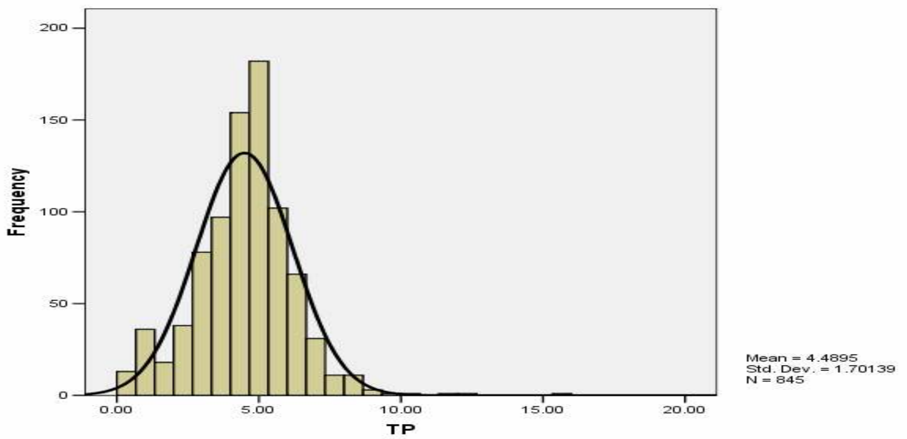


Figure 3.8 IMWWTP frequency graphic of TP in effluent data

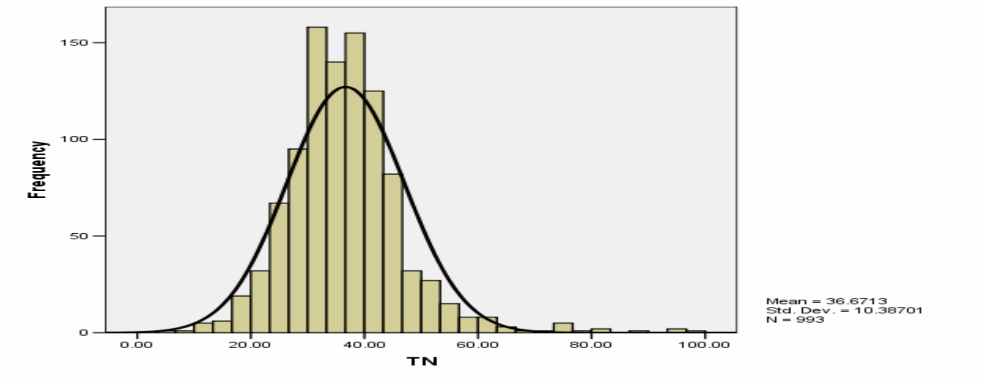


Figure 3.9 IMWWTP frequency graphic of TN in influent data

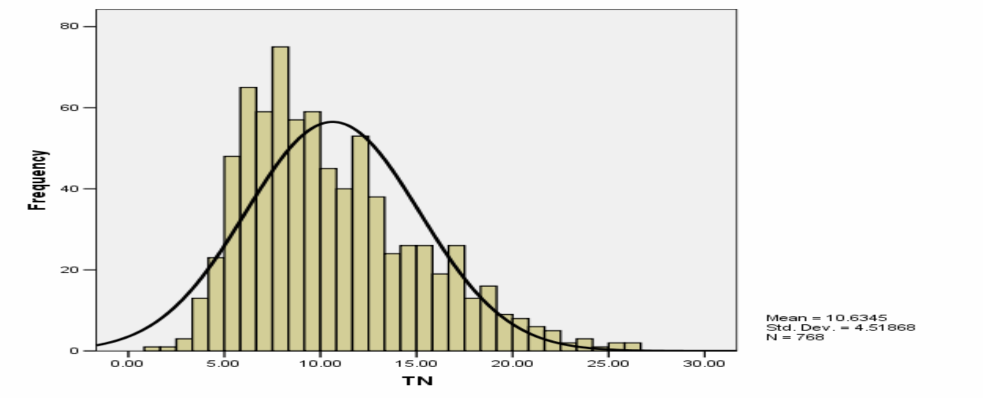


Figure 3.10 IMWWTP frequency graphic of TN in effluent data

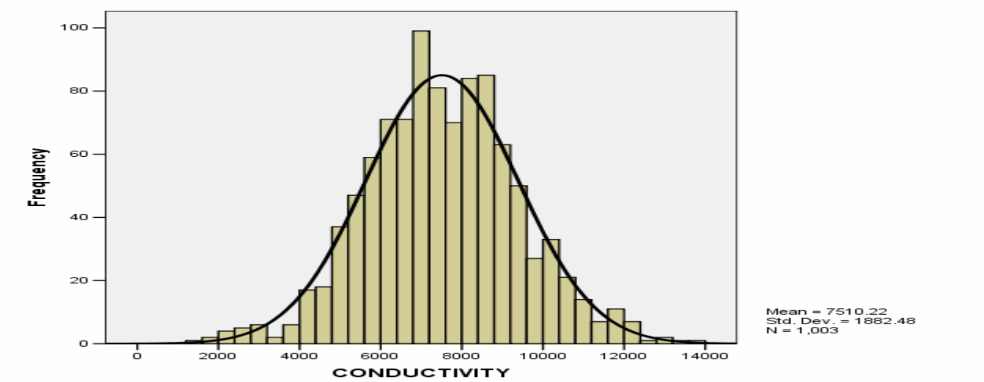


Figure 3.11 IMWWTP frequency graphic of conductivity in influent data

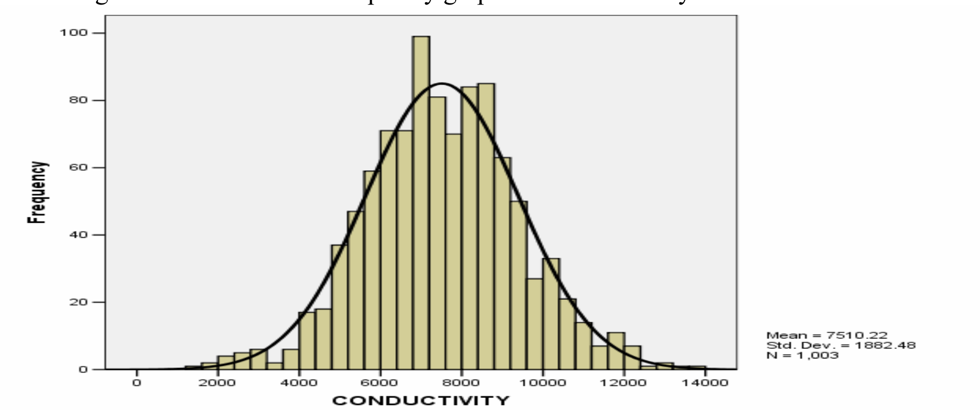


Figure 3.12 IMWWTP frequency graphic of conductivity in effluent data

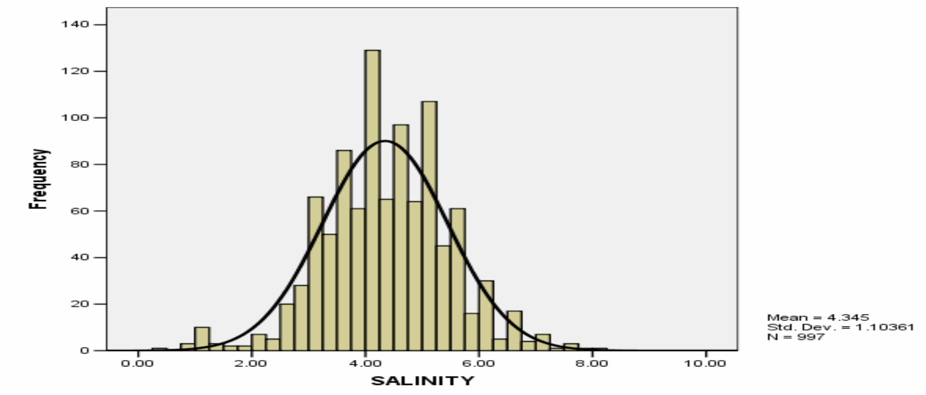


Figure 3.13 IMWWTP frequency graphic of salinity in influent data

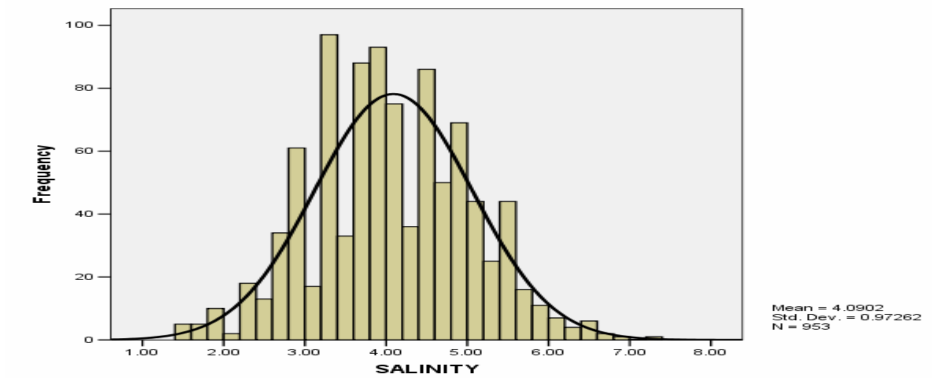


Figure 3.14 IMWWTP frequency graphic of salinity in effluent data

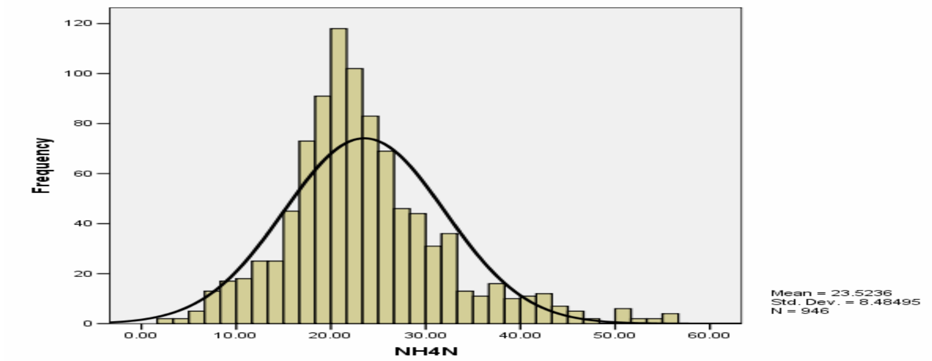


Figure 3.15 IMWWTP frequency graphic of NH_4N in influent data

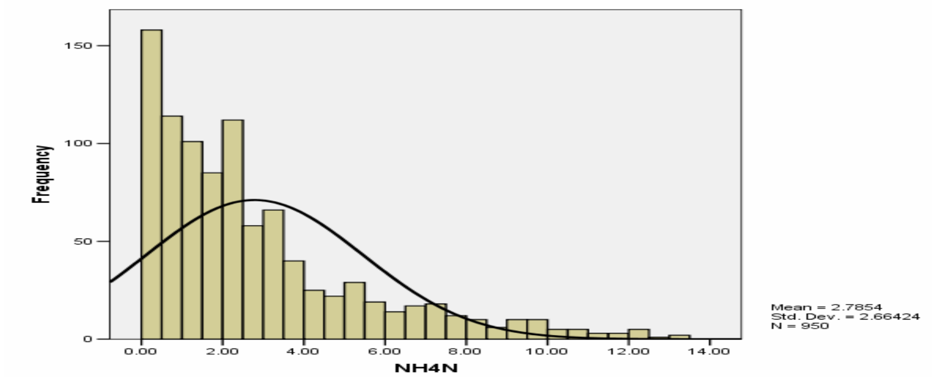


Figure 3.16 IMWWTP frequency graphic of NH_4N in effluent data

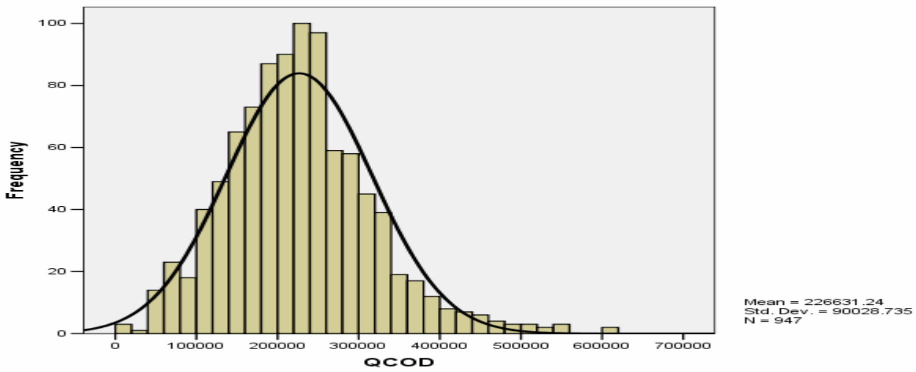


Figure 3.17 IMWWTP frequency graphic of QCOD in influent data

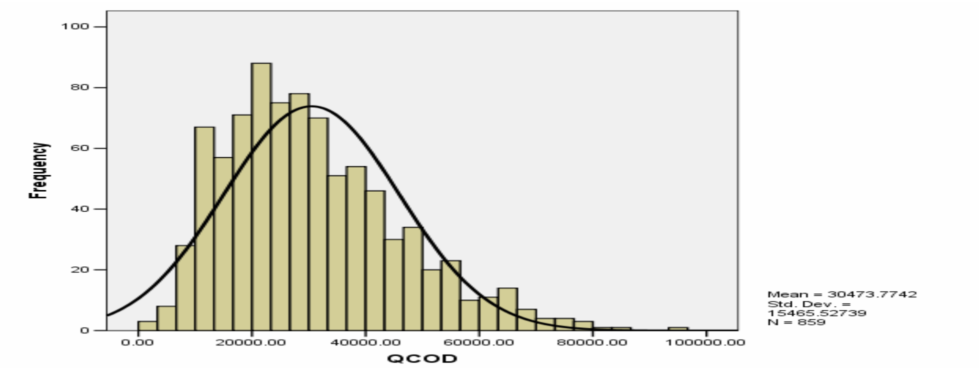


Figure 3.18 IMWWTP frequency graphic of QCOD in effluent data

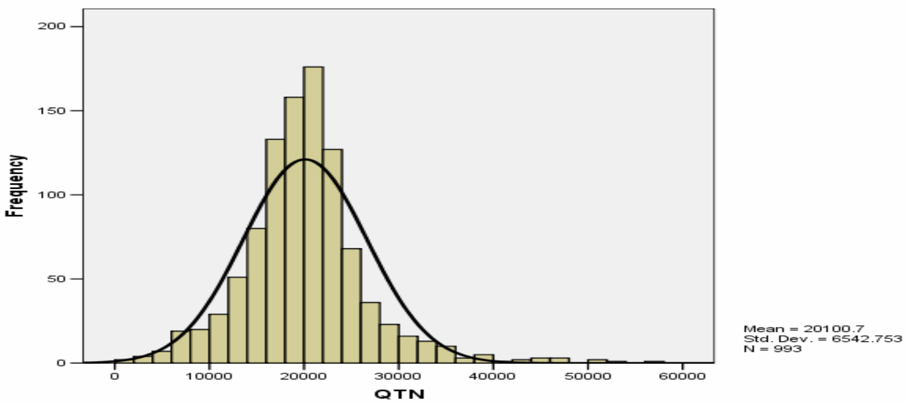


Figure 3.19 IMWWTP frequency graphic of QTN in influent data

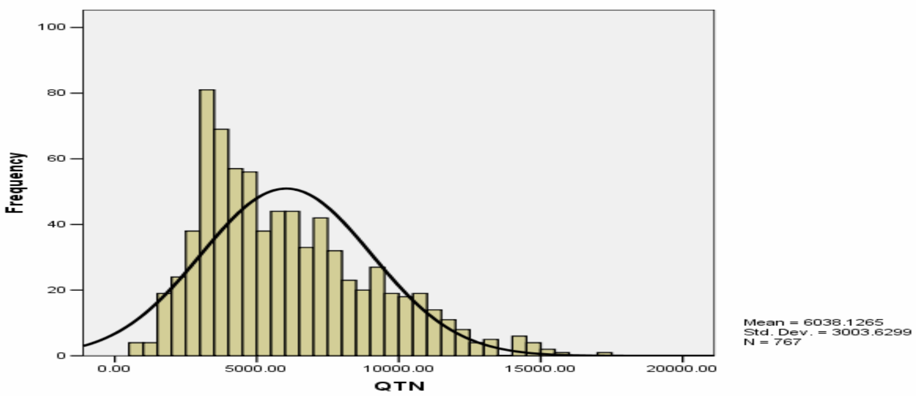


Figure 3.20 IMWWTP frequency graphic of QTN effluent data

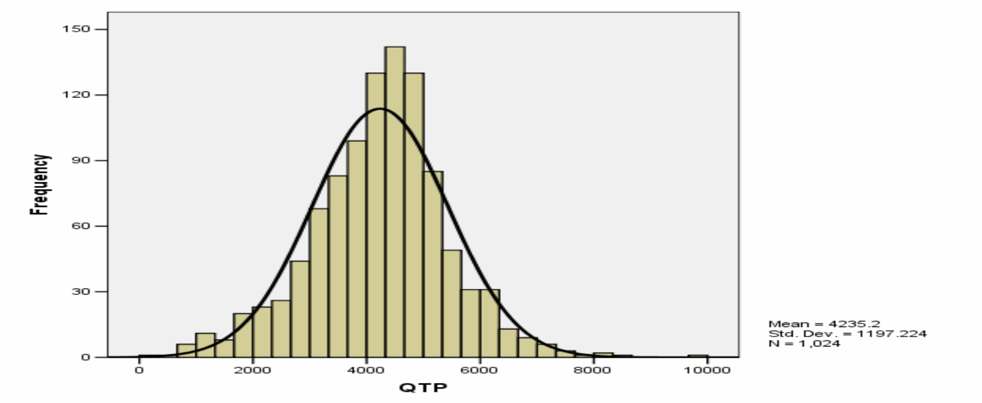


Figure 3.21 IMWWTP frequency graphic of QTP influent data

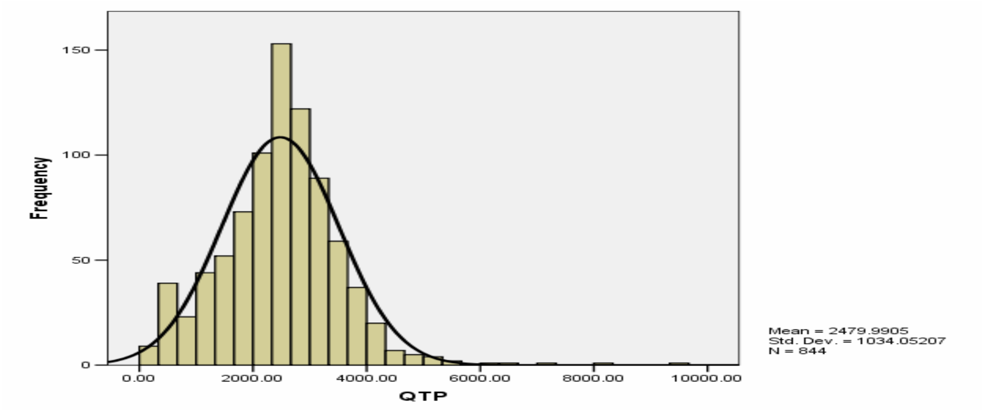


Figure 3.22 IMWWTP frequency graphic of QTP in effluent data

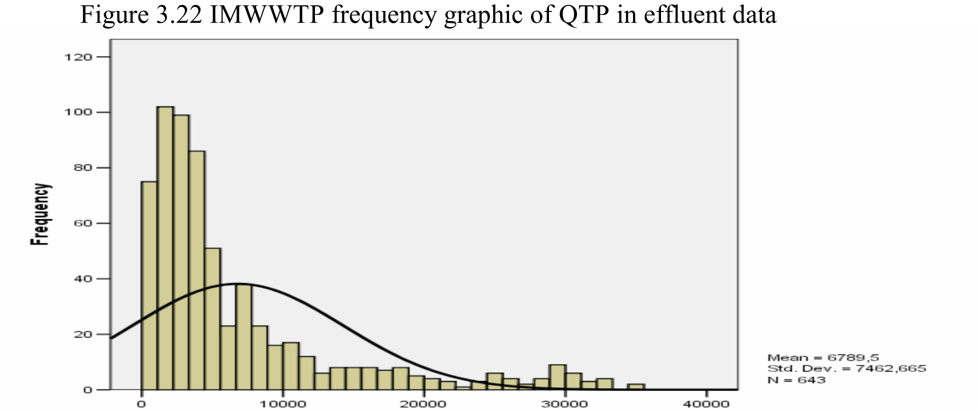


Figure 3.23 IMWWTP Frequency graphic of QBOD influent data

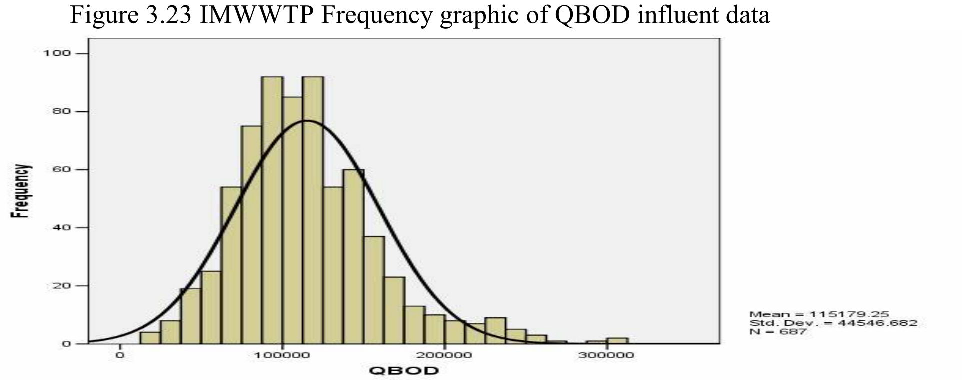


Figure 3.24 IMWWTP Frequency graphic of QBOD in effluent data

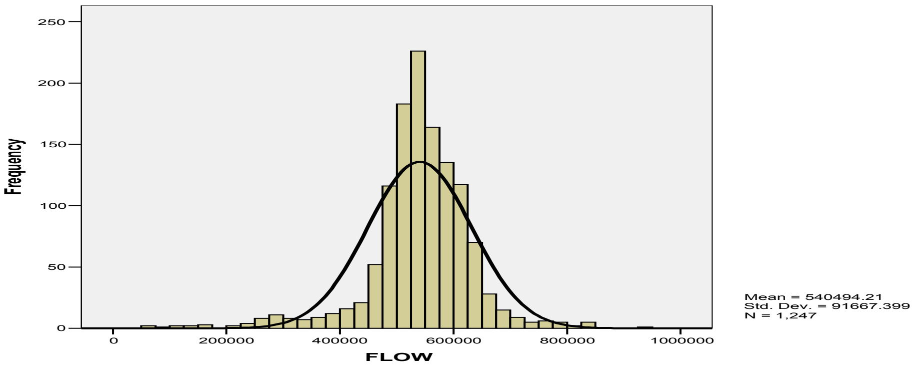


Figure 3.25 IMWWTP Frequency graphic of FLOW data

3.3 Homogeneity analysis of IMWWTP's data

By homogeneity analysis, the data which are in the same dimensions are plotted close to each other, and the data which are in different dimensions are plotted far from each other. Homogeneity analysis is applied for to obtain homogen and distribution of data set.

As we see in figures 3.26-3.28-3.30-3.31-3.32-3.33-3.34-3.35-3.36-3.38-3.40-3.42-3.43-3.44-3.45-3.46-3.48-3.50 , 1. group is far from the other groups on symmetrical graphics. These groups out of 1.group are composed homogen group. And 1.group creates abnormal distribution during data analysis. For this reason homogeneity analysis are used and heterogeneous data are established. In Figure 3.37-3.39-3.47 7. group does not have a homogeneous distribution. 1. group's distiribution is located far from other groups.

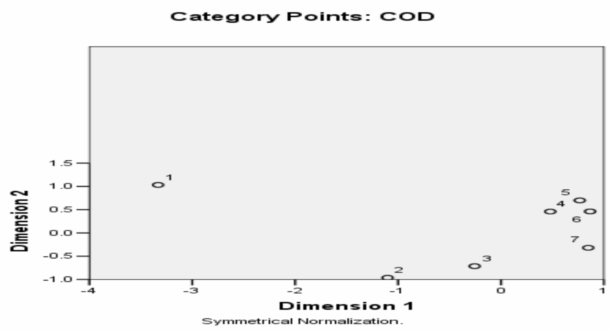


Figure 3.26 Symmetrical normalization of IMWWTP' s influent data of COD

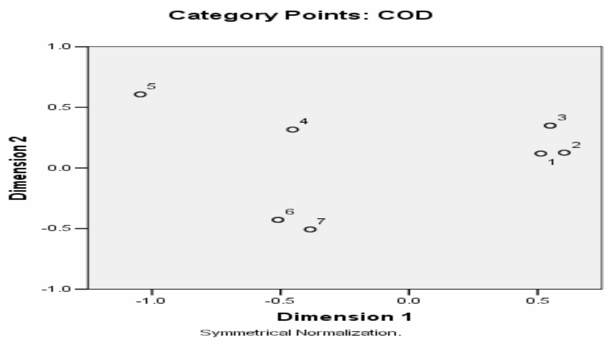


Figure 3.27 Symmetrical normalization of IMWWTP' s effluent data of COD

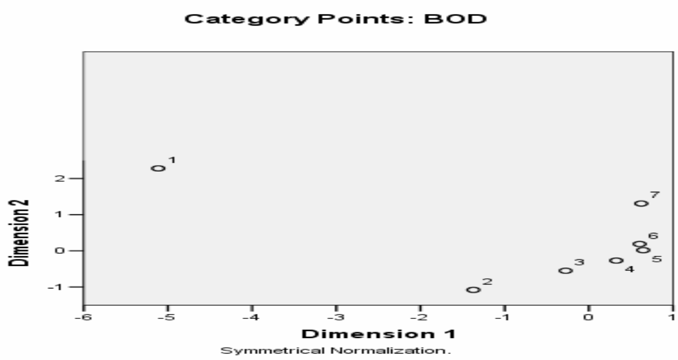


Figure 3.28 Symmetrical normalization of IMWWTP' s influent data of BOD

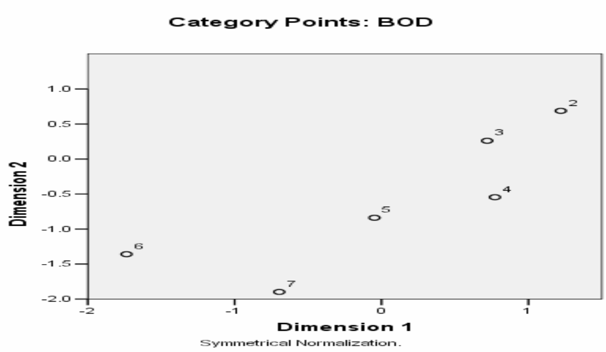


Figure 3.29 Symmetrical normalization of IMWWTP's influent data of BOD

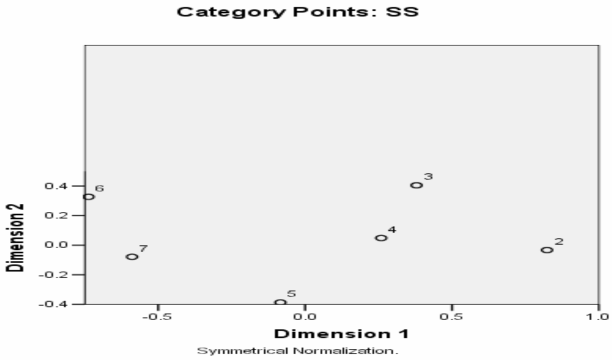


Figure 3.30 Symmetrical normalization of IMWWTP' s influent data of SS

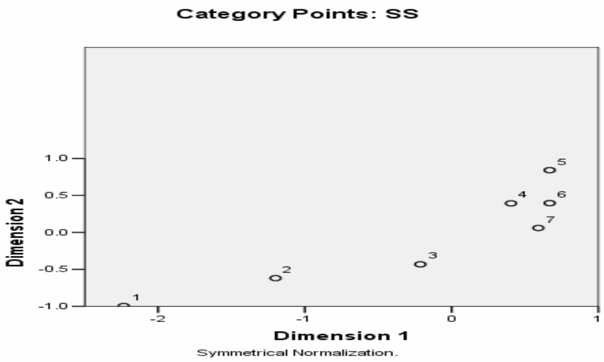


Figure 3.31 Symmetrical normalization of IMWWTP' s effluent data of SS

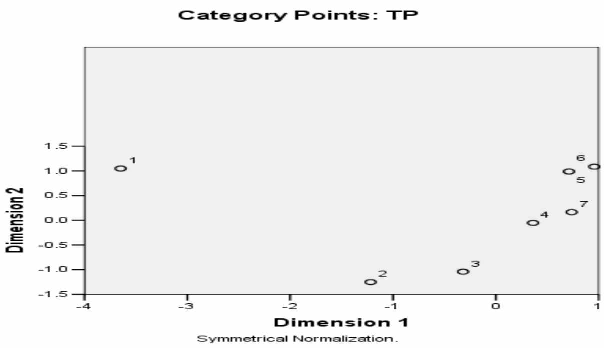


Figure 3.32 Symmetrical normalization of IMWWTP' s influent data of TP

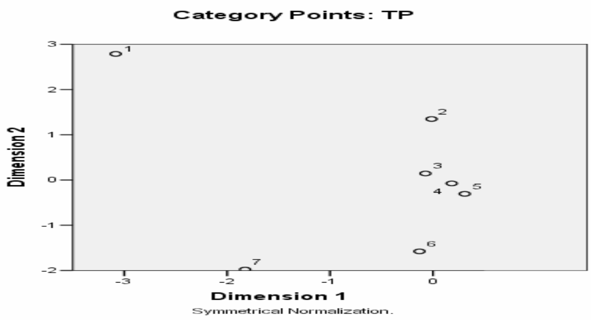


Figure 3.33 Symmetrical normalization of IMWWTP' s effluent data of TP

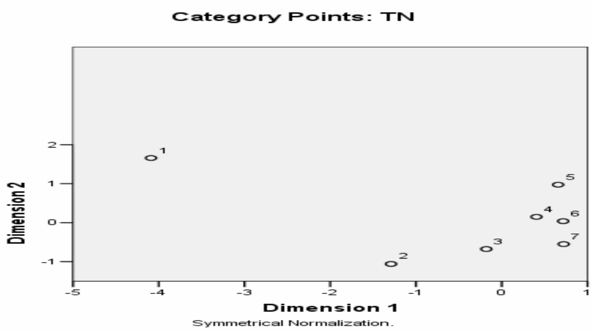


Figure 3.34 Symmetrical normalization of IMWWTP' s influent data of TN

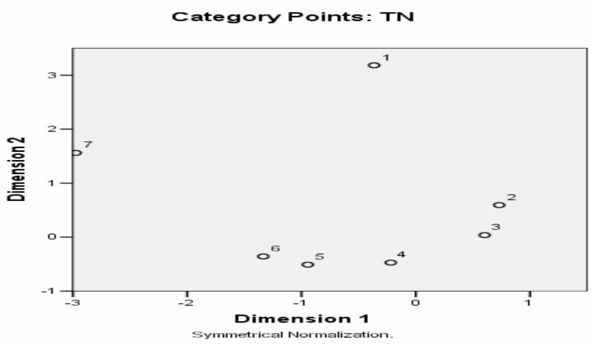


Figure 3.35 Symmetrical normalization of IMWWTP' s effluent data of TN

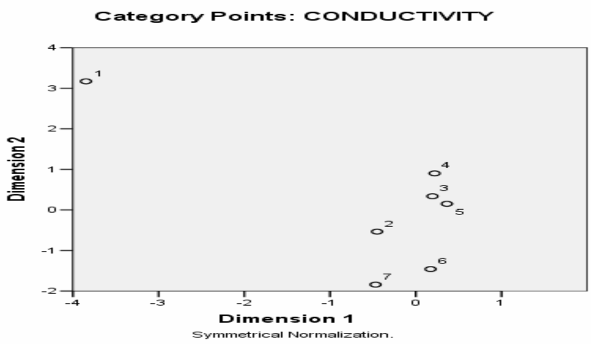


Figure 3.36 Symmetrical normalization of IMWWTP' s influent data of CONDUCTIVITY

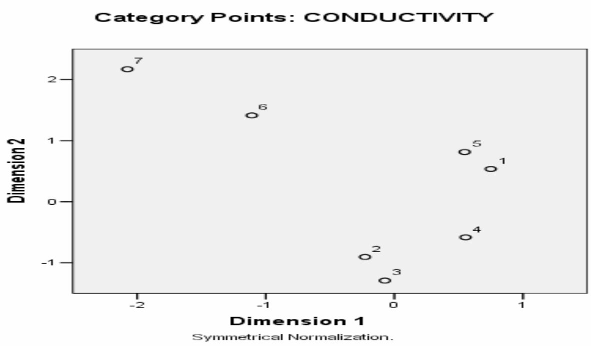


Figure 3.37 Symmetrical normalization of IMWWTP' s effluent data of CONDUCTIVITY

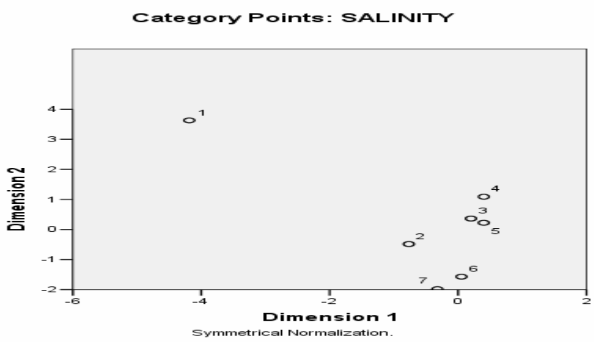


Figure 3.38 Symmetrical normalization of IMWWTP' s influent data of SALINITY

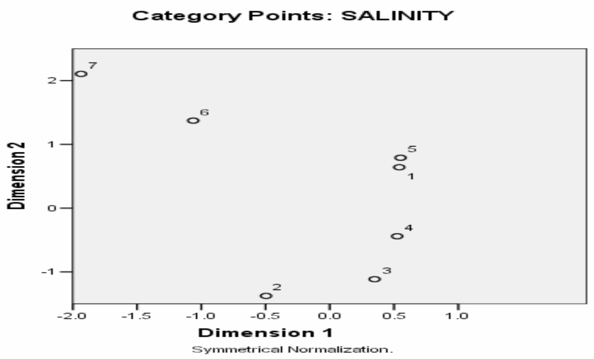


Figure 3.39 Symmetrical normalization of IMWWTP' s effluent data of SALINITY

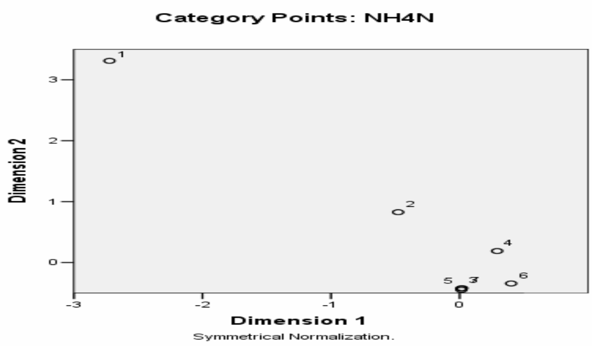


Figure 3.40 Symmetrical normalization of IMWWTP' s influent data of NH_4N

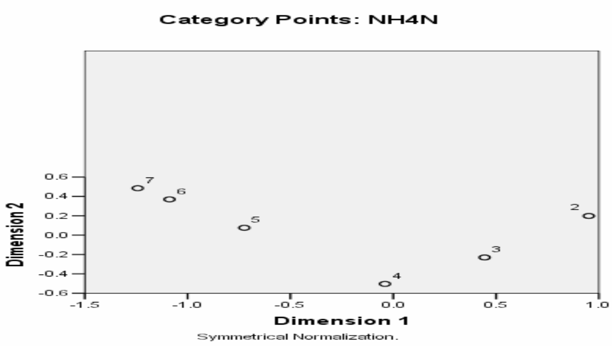


Figure 3.41 Symmetrical normalization of IMWWTP' s influent data of NH_4N

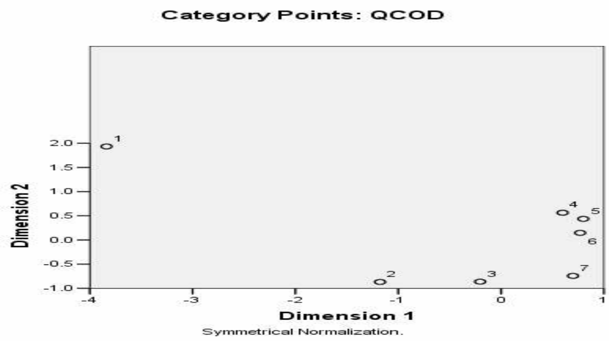


Figure 3.42 Symmetrical normalization of IMWWTP' s effluent data of QCOD

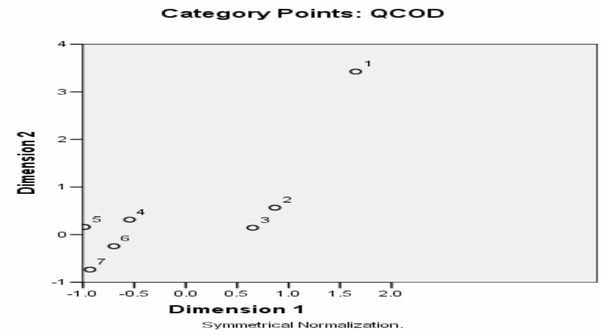


Figure 3.43 Symmetrical normalization of IMWWTP' s effluent data of QCOD

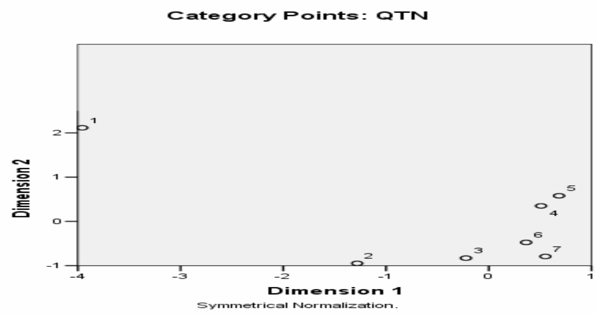


Figure 3.44 Symmetrical normalization of IMWWTP' s influent data of QTN

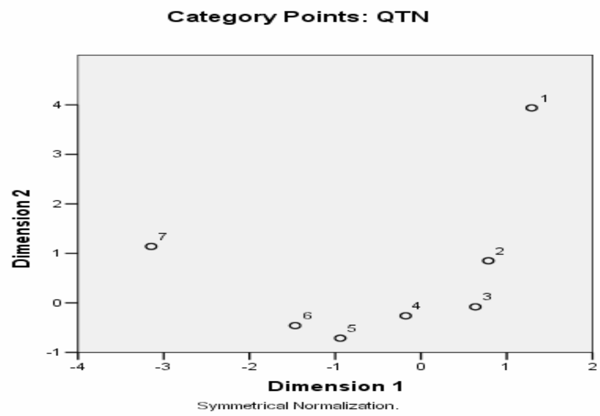


Figure 3.45 Symmetrical normalization of IMWWTP' s effluent data of QTN

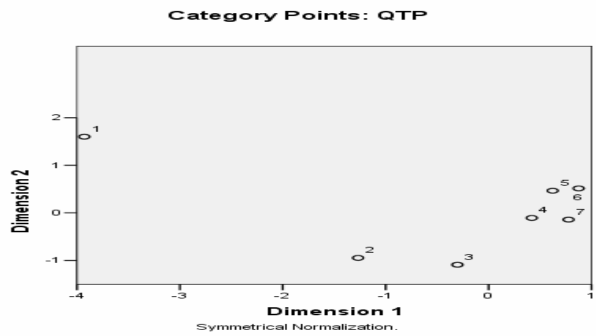


Figure 3.46 Symmetrical normalization of IMWWTP' s influent data of QTP

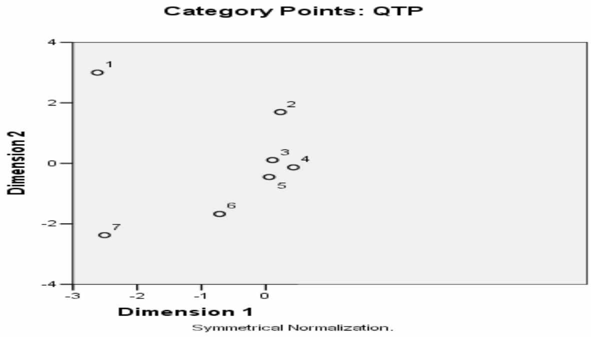


Figure 3.47 Symmetrical normalization of IMWWTP' s effluent data of QTP

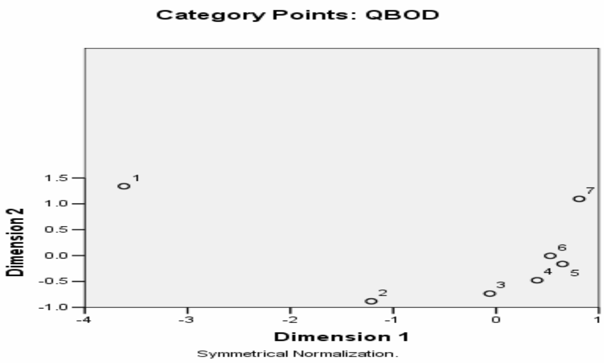


Figure 3.48 Symmetrical normalization of IMWWTP' s influent data of QBOD

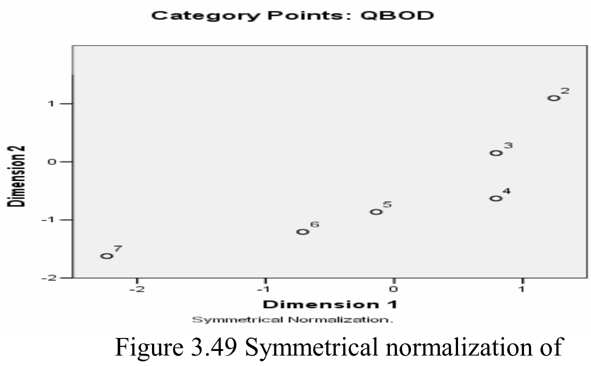


Figure 3.49 Symmetrical normalization of IMWWTP' s effluent data of QBOD

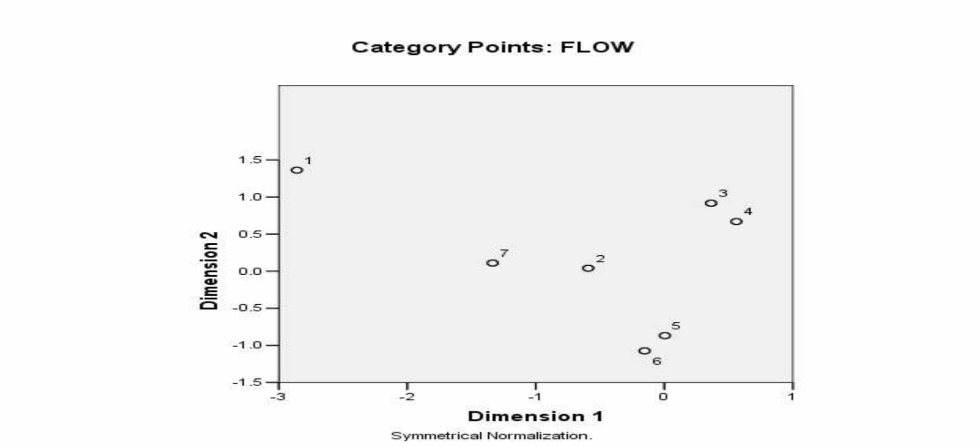


Figure 3.50 Symmetrical normalization of IMWWTP' s data of FLOW

3.4 Correlation Analysis of IMWWTP's data

In this part of the study, correlation analysis are carried out to check whether there is a linear relationship between variables or not. Correlation coefficients for IMWWTP's influent data is given in Table 3.5. Correlation coefficient of COD-SS association is found as 0.468 which means COD-SS correlation is strong ($p<0.05$). Similar strong correlations are found between COD-TP (0.427), COD-BOD_5 (0.283), COD-TN (0.238), BOD_5-TP (0.354), SS-TP (0.305), TP-TN (0.473) according to Spearman correlation

Correlation coefficients for IMWWTP's effluent data is given in Table 3.6. Correlation coefficients are found for COD-SS (0.300), COD-CONDUCTIVITY (0.271), COD-SALINITY (0.232), BOD5-TN (0.267), BOD5-NH_4-N (0.307) according to spearman correlation.

Table 3.5 Correlation table of IMWWTP's influent data

Correlations

			COD	BOD	SS	TP	TN	CONDUCTIVITY	SALINITY	NH4N	FLOW
Kendall's tau_b	COD	Correlation Coefficient	1,000	,199**	,333**	,297**	,161**	,139**	,175**	,060**	-,066**
		Sig. (2-tailed)	.	,000	,000	,000	,000	,000	,000	,010	,001
		N	1081	800	1052	1000	959	867	856	819	1081
	BOD	Correlation Coefficient	,199**	1,000	,189**	,250**	,188**	-,097**	-,083**	,064*	-,159**
		Sig. (2-tailed)	,000	.	,000	,000	,000	,000	,003	,019	,000
		N	800	833	814	790	756	676	647	649	833
	SS	Correlation Coefficient	,333**	,189**	1,000	,210**	,153**	,082**	,104**	,019	-,106**
		Sig. (2-tailed)	,000	,000	.	,000	,000	,000	,000	,408	,000
		N	1052	814	1094	1005	968	879	867	825	1094
	TP	Correlation Coefficient	,297**	,250**	,210**	1,000	,334**	-,004	-,011	,038	-,144**
		Sig. (2-tailed)	,000	,000	,000	.	,000	,860	,639	,105	,000
		N	1000	790	1005	1034	961	835	822	798	1034
	TN	Correlation Coefficient	,161**	,188**	,153**	,334**	1,000	,076**	,068**	,072**	-,083**
		Sig. (2-tailed)	,000	,000	,000	,000	.	,002	,004	,003	,000
		N	959	756	968	961	993	789	807	752	993
	CONDUCTIVITY	Correlation Coefficient	,139**	-,097**	,082**	-,004	,076**	1,000	,839**	,021	,040
		Sig. (2-tailed)	,000	,000	,000	,860	,002	.	,000	,351	,060
		N	867	676	879	835	789	1003	972	892	1003
	SALINITY	Correlation Coefficient	,175**	-,083**	,104**	-,011	,068**	,839**	1,000	,037	,048*
		Sig. (2-tailed)	,000	,003	,000	,639	,004	,000	.	,106	,025
		N	856	647	867	822	807	972	997	886	997
	NH4N	Correlation Coefficient	,060**	,064*	,019	,038	,072**	,021	,037	1,000	,159**
		Sig. (2-tailed)	,010	,019	,408	,105	,003	,351	,106	.	,000
		N	819	649	825	798	752	892	886	946	946
	FLOW	Correlation Coefficient	-,066**	-,159**	-,106**	-,144**	-,083**	,040	,048*	,159**	1,000
		Sig. (2-tailed)	,001	,000	,000	,000	,000	,060	,025	,000	.
		N	1081	833	1094	1034	993	1003	997	946	1247
Spearman's rho	COD	Correlation Coefficient	1,000	,283**	,468**	,427**	,238**	,205**	,253**	,088*	-,102**
		Sig. (2-tailed)	.	,000	,000	,000	,000	,000	,000	,012	,001
		N	1081	800	1052	1000	959	867	856	819	1081
	BOD	Correlation Coefficient	,283**	1,000	,270**	,354**	,268**	-,127**	-,101*	,095*	-,225**
		Sig. (2-tailed)	,000	.	,000	,000	,000	,001	,010	,016	,000
		N	800	833	814	790	756	676	647	649	833
	SS	Correlation Coefficient	,468**	,270**	1,000	,305**	,227**	,118**	,148**	,028	-,158**
		Sig. (2-tailed)	,000	,000	.	,000	,000	,000	,000	,419	,000
		N	1052	814	1094	1005	968	879	867	825	1094
	TP	Correlation Coefficient	,427**	,354**	,305**	1,000	,473**	-,004	-,015	,057	-,211**
		Sig. (2-tailed)	,000	,000	,000	.	,000	,897	,666	,110	,000
		N	1000	790	1005	1034	961	835	822	798	1034
	TN	Correlation Coefficient	,238**	,268**	,227**	,473**	1,000	,108**	,097**	,106**	-,118**
		Sig. (2-tailed)	,000	,000	,000	,000	.	,002	,006	,004	,000
		N	959	756	968	961	993	789	807	752	993
	CONDUCTIVITY	Correlation Coefficient	,205**	-,127**	,118**	-,004	,108**	1,000	,948**	,032	,056
		Sig. (2-tailed)	,000	,001	,000	,897	,002	.	,000	,335	,078
		N	867	676	879	835	789	1003	972	892	1003
	SALINITY	Correlation Coefficient	,253**	-,101*	,148**	-,015	,097**	,948**	1,000	,055	,063*
		Sig. (2-tailed)	,000	,010	,000	,666	,006	,000	.	,100	,045
		N	856	647	867	822	807	972	997	886	997
	NH4N	Correlation Coefficient	,088*	,095*	,028	,057	,106**	,032	,055	1,000	,233**
		Sig. (2-tailed)	,012	,016	,419	,110	,004	,335	,100	.	,000
		N	819	649	825	798	752	892	886	946	946
	FLOW	Correlation Coefficient	-,102**	-,225**	-,158**	-,211**	-,118**	,056	,063*	,233**	1,000
		Sig. (2-tailed)	,001	,000	,000	,000	,000	,078	,045	,000	.
		N	1081	833	1094	1034	993	1003	997	946	1247

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table 3.6 Correlation table of IMWWTP' s effluent data

Correlations

			COD	BOD	SS	TP	TN	CONDUCTIVITY	SALINITY	NH4N	FLOW
Kendall's tau_b	COD	Correlation Coefficient	1,000	-,021	,203**	,052*	,054*	,181**	,158**	,005	,067**
		Sig. (2-tailed)	.	,538	,000	,035	,040	,000	,000	,829	,003
		N	863	445	749	733	660	761	728	736	863
	BOD	Correlation Coefficient	-,021	1,000	-,053	-,023	,193**	-,140**	-,197**	,215**	,140**
		Sig. (2-tailed)	,538	.	,094	,485	,000	,000	,000	,000	,000
		N	445	594	499	440	409	507	489	506	594
	SS	Correlation Coefficient	,203**	-,053	1,000	,070**	,030	,030	-,002	,009	,081**
		Sig. (2-tailed)	,000	,094	.	,005	,259	,197	,933	,720	,000
		N	749	499	964	720	644	842	806	800	964
	TP	Correlation Coefficient	,052*	-,023	,070**	1,000	-,077**	-,099**	-,157**	-,115**	-,058*
		Sig. (2-tailed)	,035	,485	,005	.	,002	,000	,000	,000	,012
		N	733	440	720	845	730	778	746	759	845
	TN	Correlation Coefficient	,054*	,193**	,030	-,077**	1,000	,001	-,011	,184**	,266**
		Sig. (2-tailed)	,040	,000	,259	,002	.	,979	,661	,000	,000
		N	660	409	644	730	768	698	722	697	768
	CONDUCTIVITY	Correlation Coefficient	,181**	-,140**	,030	-,099**	,001	1,000	,864**	-,005	,023
		Sig. (2-tailed)	,000	,000	,197	,000	,979	.	,000	,818	,280
		N	761	507	842	778	698	985	926	838	985
	SALINITY	Correlation Coefficient	,158**	-,197**	-,002	-,157**	-,011	,864**	1,000	,000	,026
		Sig. (2-tailed)	,000	,000	,933	,000	,661	,000	.	,985	,233
		N	728	489	806	746	722	926	953	816	953
	NH4N	Correlation Coefficient	,005	,215**	,009	-,115**	,184**	-,005	,000	1,000	,168**
		Sig. (2-tailed)	,829	,000	,720	,000	,000	,818	,985	.	,000
		N	736	506	800	759	697	838	816	928	928
	FLOW	Correlation Coefficient	,067**	,140**	,081**	-,058*	,266**	,023	,026	,168**	1,000
		Sig. (2-tailed)	,003	,000	,000	,012	,000	,280	,233	,000	.
		N	863	594	964	845	768	985	953	928	1247
Spearman's rho	COD	Correlation Coefficient	1,000	-,030	,300**	,081*	,079*	,271**	,232**	,008	,102**
		Sig. (2-tailed)	.	,527	,000	,028	,042	,000	,000	,828	,003
		N	863	445	749	733	660	761	728	736	863
	BOD	Correlation Coefficient	-,030	1,000	-,076	-,026	,267**	-,203**	-,274**	,307**	,205**
		Sig. (2-tailed)	,527	.	,090	,587	,000	,000	,000	,000	,000
		N	445	594	499	440	409	507	489	506	594
	SS	Correlation Coefficient	,300**	-,076	1,000	,106**	,044	,043	-,003	,014	,120**
		Sig. (2-tailed)	,000	,090	.	,004	,267	,217	,922	,699	,000
		N	749	499	964	720	644	842	806	800	964
	TP	Correlation Coefficient	,081*	-,026	,106**	1,000	-,116**	-,147**	-,225**	-,173**	-,087*
		Sig. (2-tailed)	,028	,587	,004	.	,002	,000	,000	,000	,012
		N	733	440	720	845	730	778	746	759	845
	TN	Correlation Coefficient	,079*	,267**	,044	-,116**	1,000	,004	-,014	,269**	,403**
		Sig. (2-tailed)	,042	,000	,267	,002	.	,912	,701	,000	,000
		N	660	409	644	730	768	698	722	697	768
	CONDUCTIVITY	Correlation Coefficient	,271**	-,203**	,043	-,147**	,004	1,000	,963**	-,004	,032
		Sig. (2-tailed)	,000	,000	,217	,000	,912	.	,000	,909	,311
		N	761	507	842	778	698	985	926	838	985
	SALINITY	Correlation Coefficient	,232**	-,274**	-,003	-,225**	-,014	,963**	1,000	,004	,033
		Sig. (2-tailed)	,000	,000	,922	,000	,701	,000	.	,905	,314
		N	728	489	806	746	722	926	953	816	953
	NH4N	Correlation Coefficient	,008	,307**	,014	-,173**	,269**	-,004	,004	1,000	,253**
		Sig. (2-tailed)	,828	,000	,699	,000	,000	,909	,905	.	,000
		N	736	506	800	759	697	838	816	928	928
	FLOW	Correlation Coefficient	,102**	,205**	,120**	-,087*	,403**	,032	,033	,253**	1,000
		Sig. (2-tailed)	,003	,000	,000	,012	,000	,311	,314	,000	.
		N	863	594	964	845	768	985	953	928	1247

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

3.5 Scatter graphics of inluent and effluent data of IMWWTP

Scatter graphics display the linear association between two variables. Before Regression analysis, the association can be observed simply on scatter graphics. Scatter graphics (Figure 3.51-Figure 3.71) are prepeared for 1247 data and 12 variables of IMWWTP' s influent and effluent data. And linear association is obtained between COD-SS .The strong association are also obtain between COD-BOD (0.283), COD-TN 0.238), COD-TP (0.297), BOD-TP (0.354), SS-TP (0.305), TP-TN (0.334) values. We can see correlation coefficients of IWWTP's influent data at Table 3.7 and when we compare graphics and this table, we got same result both graphics and the table about association between variable. Similar relations are observed between COD-CONDUCTIVITY (0.271), COD-SS (0.300), COD-SALINITY (0.232), BOD-TN (0.267), BOD-NH_4-N (0.307), IQCOD-EQCOD (0.213) on graphics of IMWWTP's effluent values.

Table 3.7 Correlation coefficients of IWWTP's influent data

	COD-BOD	BOD-TP	COD-SS	COD-TN	BOD-TP	TP-SS	TP-TN
Correlation coefficient	0.283	0.354	0.468	0.238	0.427	0.305	0.334
sig.	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 3.8 Correlation coefficients of IWWTP's effluent data

	COD-CONDUC.	COD-SS	COD-SAL.	BOD-TN	BOD-NH4-N
Correlation coefficient	0.271	0.3	0.232	0.267	0.307
sig.	0.000	0.000	0.000	0.000	0.000

Table 3.9 Correlation coefficients of IWWTP's effluent data

	IQCOD-EQCOD	IQBOD-EQBOD	IQSS-EQSS	IQTN-EQTN	IQTP-EQTP
Correlation coefficient	0.213	0.180	0.089	0.199	0.117
sig.	0.000	0.001	0.009	0.000	0.000

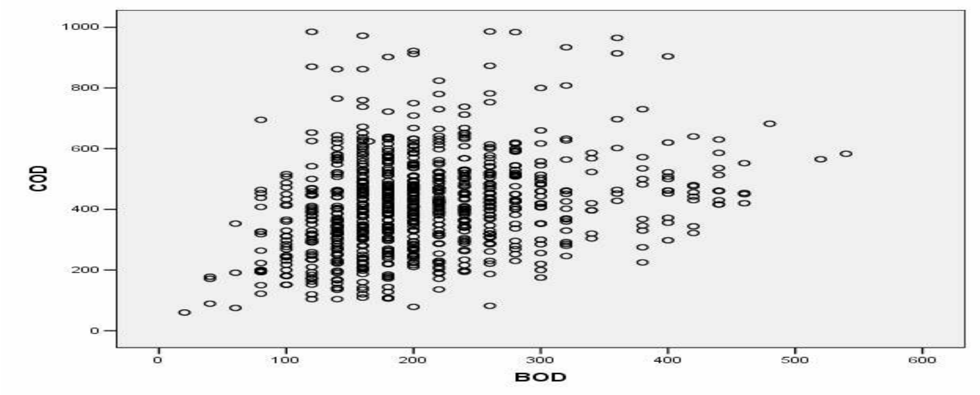


Figure 3.51 Scatter graphic of IMWWTP' s influent COD-BOD data

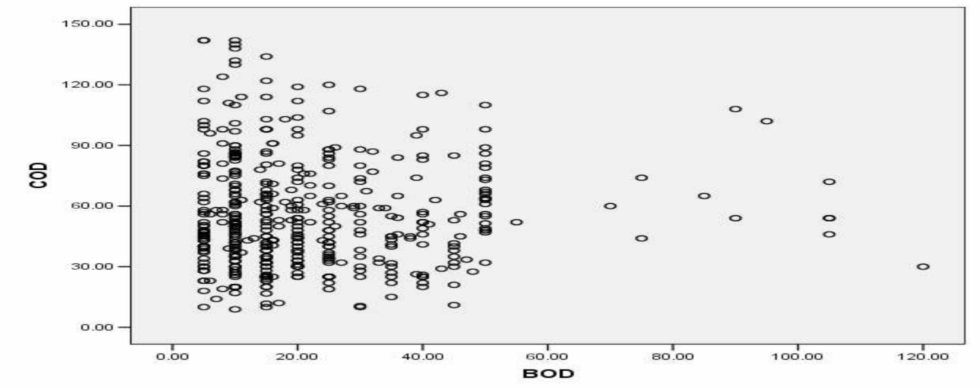


Figure 3.52 Scatter graphic of IMWWTP' s effluent COD-BOD data

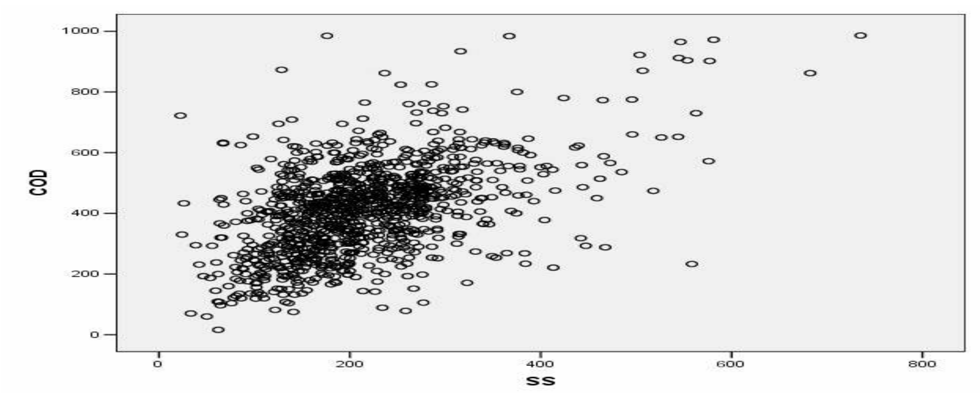


Figure 3.53 Scatter graphic of IMWWTP' s influent COD-SS data

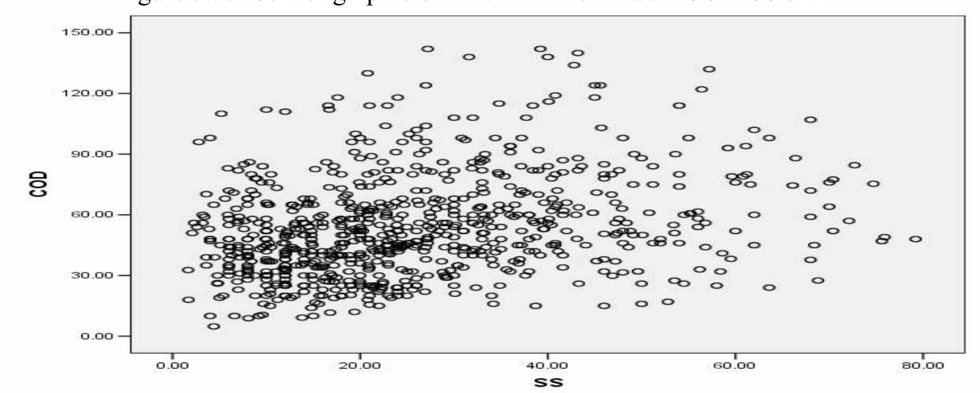


Figure 3.54 Scatter graphic of IMWWTP' s effluent COD-SS data

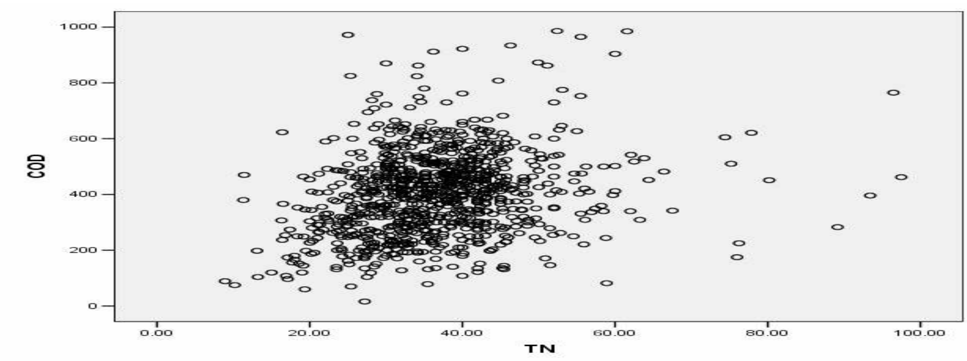


Figure 3.55 Scatter graphic of IMWWTP' s influent COD-TN data

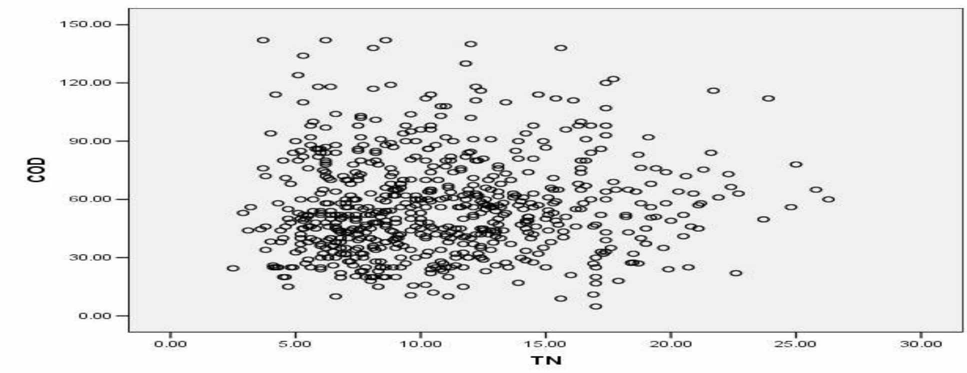


Figure 3.56 Scatter graphic of IMWWTP' s effluent COD-TN data

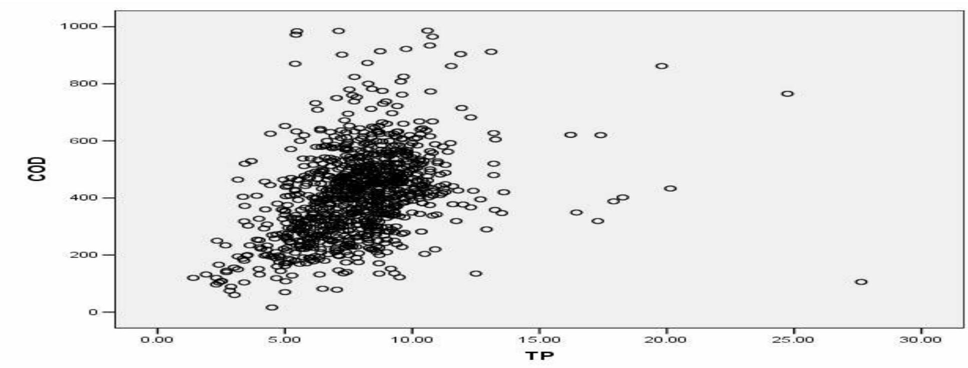


Figure 3.57 Scatter graphic of IMWWTP' s influent COD-TP data

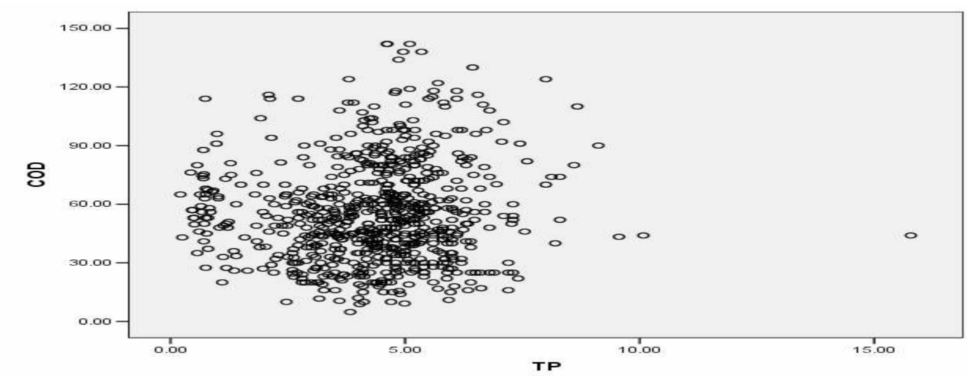


Figure 3.58 Scatter graphic of IMWWTP' s effluent COD-TP data

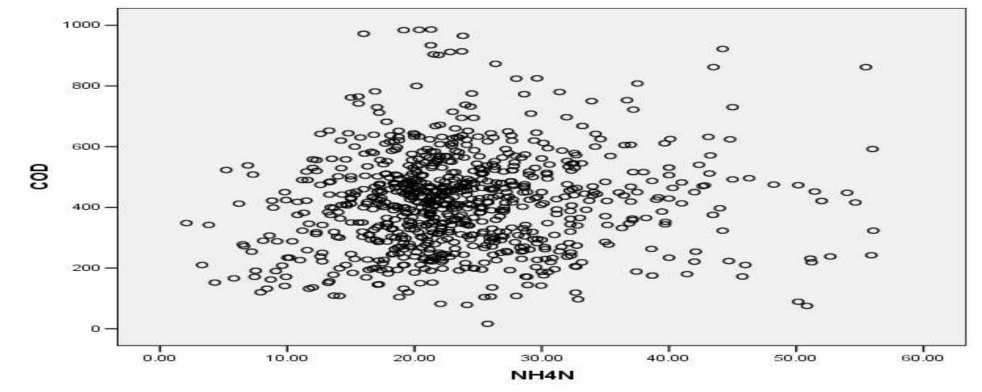


Figure 3.59 Scatter graphic of IMWWTP' s influent COD- NH_4N data

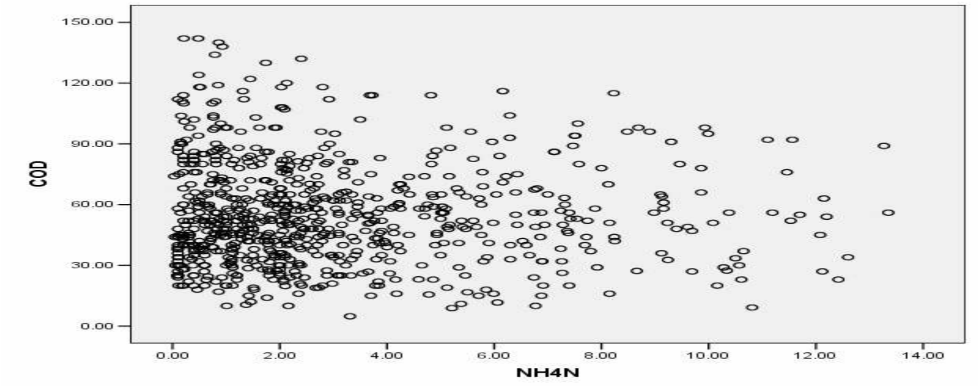


Figure 3.60 Scatter graphic of IMWWTP' s effluent COD- NH_4N data

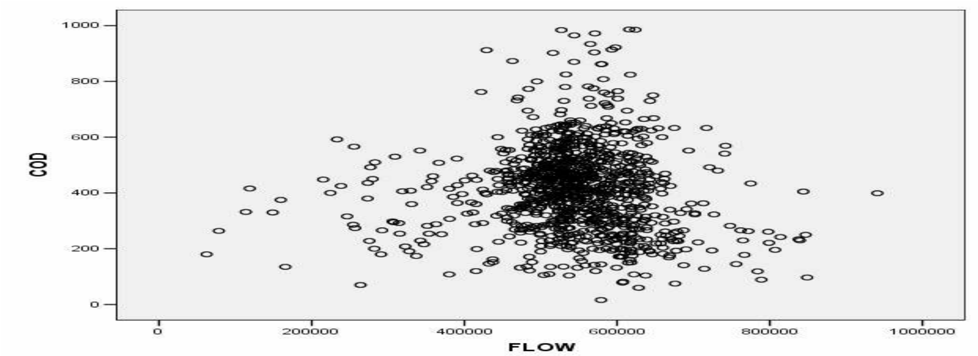


Figure 3.61 Scatter graphic of IMWWTP' s influent COD-FLOW data

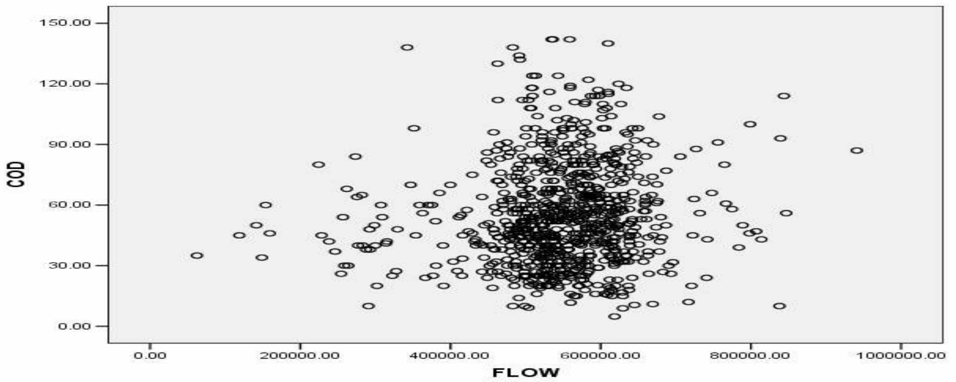


Figure 3.62 Scatter graphic of IMWWTP' s effluent COD-FLOW data

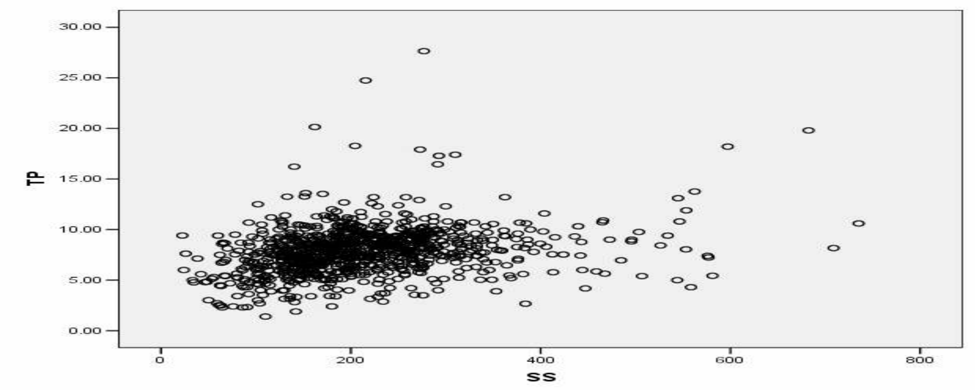


Figure 3.63 Scatter graphic of IMWWTP' s influent TP-SS data

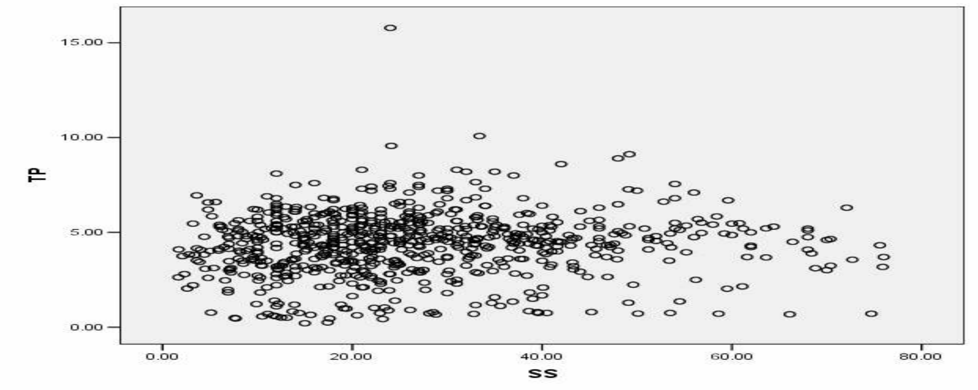


Figure 3.64 Scatter graphic of IMWWTP' s effluent TP-SS data

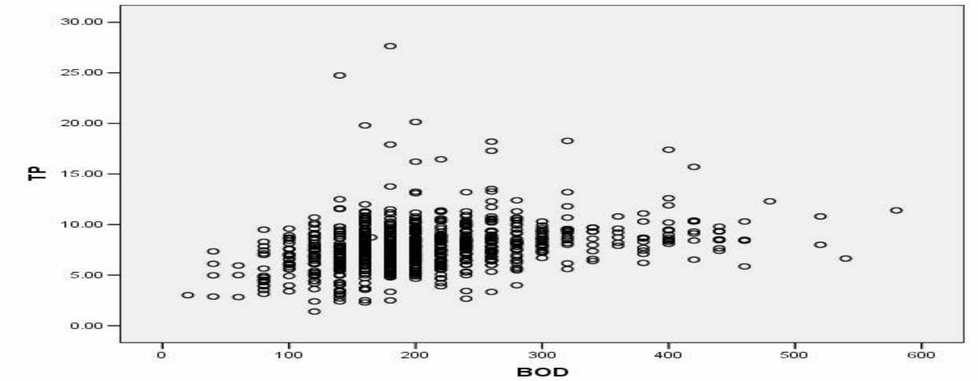


Figure 3.65 Scatter graphic of IMWWTP' s influent TP-BOD data

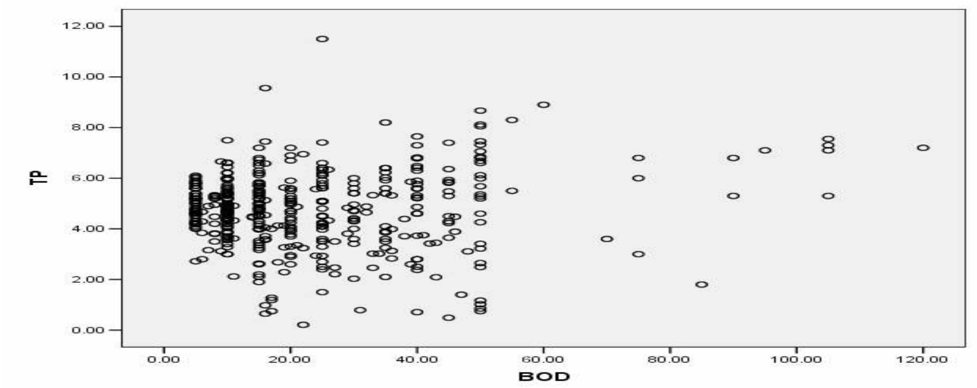


Figure 3.66 Scatter graphic of IMWWTP' s effluent TP-BOD data

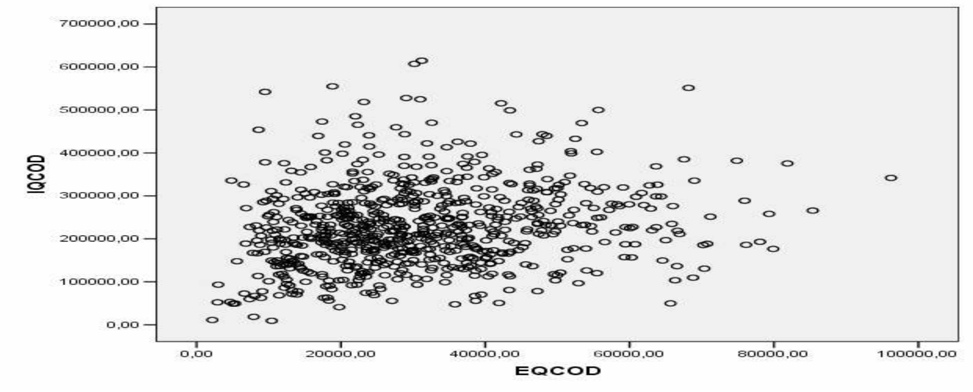


Figure 3.67 Scatter graphic of IMWWTP' s influent-effluent QCOD data

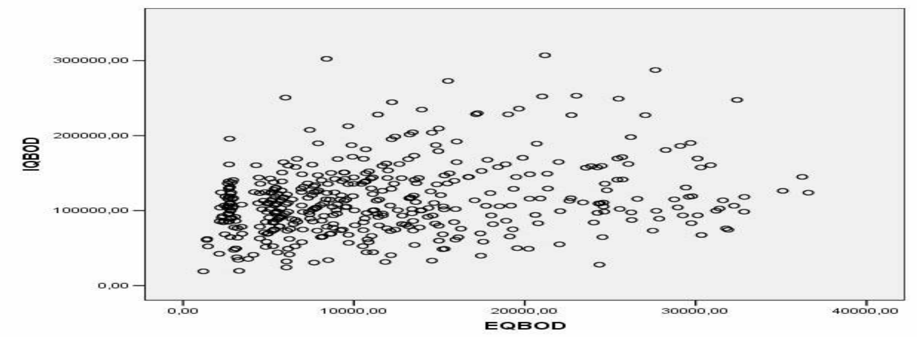


Figure 3.68 Scatter graphic of IMWWTP' s influent-effluent QBOD data

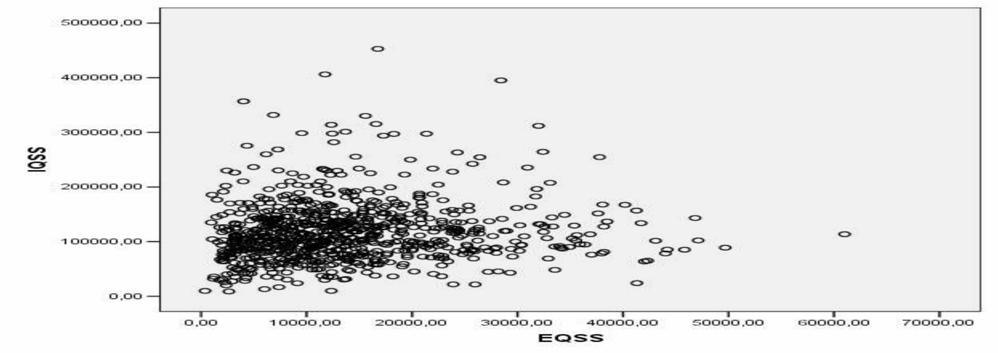


Figure 3.69 Scatter graphic of IMWWTP' s influent-effluent QSS data

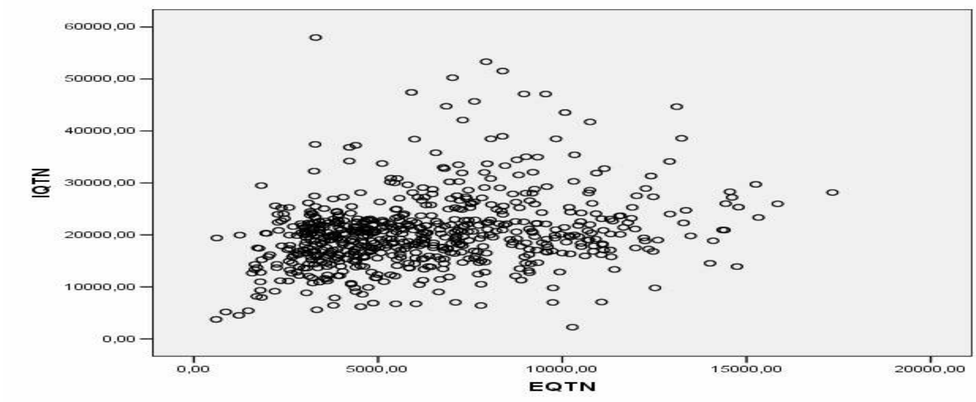


Figure 3.70 Scatter graphic of IMWWTP' s influent-effluent QTN data

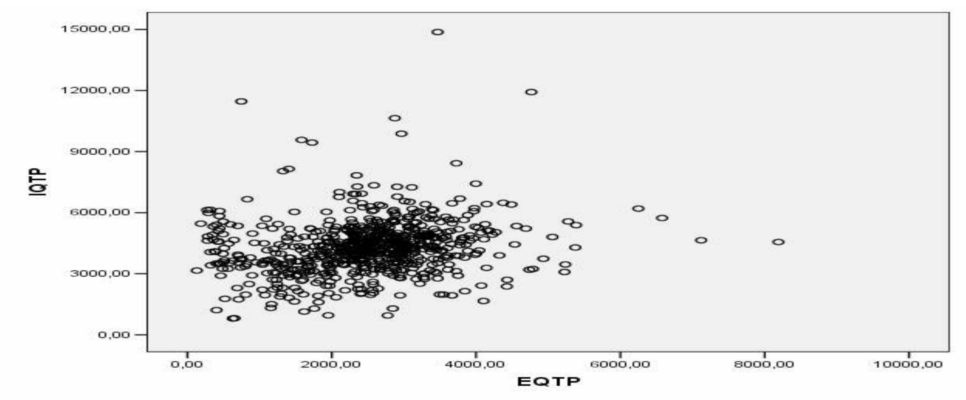


Figure 3.71 Scatter graphic of IMWWTP' s influent-effluent QTP data

3.6 Regression analysis of inluent and effluent data of IMWWTP

In this part, multiple regression analysis are applied and lineer regression methods are used. Multiple Regression can establish that a set of independent variables explains a proportion of the variance in a dependent variable at a significant level and can establish the relative predictive importance of the independent variables (Garson, 2006). The "r" coefficient also gives correlation values between dependent and independent variables. The "r-square" is a scale of a linear association between two or more variable. Also, the r-square value can be interpreted as the proportion of variation in one variable, which can be predicted from the other. The multiple regression equation is $y = b_1x_1 + b_2x_2 + ... + b_nx_n + c$. The b values are the regression coefficients, representing the amount of the dependent variable y changes, when the corresponding independent changes 1 unit. The c is the constant, where the regression line intersects the y axis, representing the amount of the dependent y value, when all the independent variables are 0 (Garson, 2006). According to Table 3.10, correlation coefficient is 0.631, r square is 0.399, which shows that the independent values are describing 63 % of the variation for the dependent variable COD. There is a very strong relation between dependent variable COD and other influent variable. At Table 3.11 Anova test showed that significant 0.00. Which means the model is significant.. It means there is a strong relation between COD and other dependent variable. At Table 3.12 just SS, TP and Salinity variables and their models are significant because of $p<0.05$. In this case H1 hypothesis is valid and we can say that there is no any relation COD-SS, COD-TP, COD-SALINITY but there is a relation between COD-BOD, COD-TN, COD-NH_4-N, COD-CONDUCTIVTY.

Ho= There is a relation between variables

H1= There is no any a relation between variables

Table 3.10 Model Summary of IMWWTP's influent values

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	,631[a]	,399	,390	126,201	,399	47,343	7	500	,000

a. Predictors: (Constant), NH4N, BOD, SALINITY, SS, TN, TP, CONDUCTIVITY

Table 3.11 ANOVA of IMWWTP influent value

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5278178	7	754025,390	47,343	,000[a]
	Residual	7963383	500	15926,766		
	Total	13241561	507			

a. Predictors: (Constant), NH4N, BOD, SALINITY, SS, TN, TP, CONDUCTIVITY

b. Dependent Variable: COD

Table 3.12 Coefficient of IMWWTP influent value

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-57,344	34,204		-1,677	,094
	BOD	,200	,078	,098	2,560	,011
	SS	,622	,066	,348	9,400	,000
	TP	19,974	2,684	,297	7,442	,000
	TN	,036	,554	,002	,064	,949
	CONDUCTIVITY	-,014	,011	-,174	-1,324	,186
	SALINITY	54,663	18,270	,391	2,992	,003
	NH4N	,457	,657	,025	,696	,487

a. Dependent Variable: COD

According to Table 3.13, correlation coefficient is 0.540, r square is 0.291, we can account for about 54 of the variation for COD. There is a very strong relation between dependent variable COD and other variables. At Table 3.14 Anova test showed that significant 0.00. Which means the model is significant. At Table 3.15 just SS-COD's significant value is < 0.05. In this case H1 hypothesis is valid for SS-

COD and we can say strong relationship between COD-BOD, COD-TP, COD-TN, COD-CONDUCTIVTY, COD-SALINITY, COD-NH_4-N.

Table 3.13 Model Summary of IMWWTP effluent value

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,540[a]	,291	,269	22,65634

a. Predictors: (Constant), FLOW, CONDUCTIVITY, SS, TP, TN, NH4N, BOD, SALINITY

Table 3.14 Anova of IMWWTP effluent value

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	52365,467	8	6545,683	12,752	,000[a]
	Residual	127300,9	248	513,310		
	Total	179666,3	256			

a. Predictors: (Constant), FLOW, CONDUCTIVITY, SS, TP, TN, NH4N, BOD, SALINITY

b. Dependent Variable: COD

Table 3.15 Coefficient of IMWWTP effluent value

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	,523	12,410		,042	,966
	BOD	-,056	,131	-,027	-,425	,671
	SS	,560	,102	,303	5,499	,000
	TP	-1,114	1,129	-,056	-,987	,325
	TN	-,367	,387	-,058	-,947	,345
	CONDUCTIVITY	,006	,004	,415	1,638	,103
	SALINITY	-1,040	6,345	-,042	-,164	,870
	NH4N	-1,632	,867	-,116	-1,883	,061
	FLOW	2,04E-005	,000	,078	1,406	,161

a. Dependent Variable: COD

3.7 Boxplot of IMWWTP values

Boxplot graphics allow us to make selections that determine the type of chart we obtain. The daily data with date of wwtp are used whole data analysis. To find extreme data which has abnormal distribution with boxplot graphics was possible for this reason boxplot graphics are prepeared for each variable.

Table 3.16 Extreme values of IWWTP's influent value

COD	BOD	SS	TP	TN	NH4N	QCOD	QTN	QTP
7/10/2003	6/4/2005	7/10/2003	12/6/2002	5/6/2002	11/5/2004	6/11/2002	5/6/2002	12/6/2002
11/9/2002	3/1/2005	28/10/200 3	29/11/2002	12/5/2002	21/9/2002	28/10/2003	12/5/2002	27/11/200 2
15/5/2002	26/4/2005	6/10/2003	3/5/2004	6/6/2002	12/10/2002	21/6/2002	6/6/2002	8/4/2003
14/5/2003	7/2/2005	11/9/2003	26/2/2005	23/4/2002	30/10/2002	30/10/2002	8/6/2002	11/2/2005
		5/4/2002		26/4/2002	24/2/2003	4/3/2003	19/4/2002	
		6/9/2003		26/4/2002			7/2/2003	
				16/3/2003				

Table 3.17 Extreme values of IWWTP's effluent value

COD	BOD	SS	TP	TN	NH4N	QCOD	QTN	QTP
13/08/2003	26/1/2005	27/7/2002	26/1/2005	5/10/2002	2/1/2004	11/11/2002	8/10/2002	26/1/2005
9/6/2003	5/10/2002		28/1/2005	15/5/2002	18/7/2002	13/8/2003	5/10/2002	24/1/2005
24/7/2003			15/7/2002	25/5/2002	5/10/2002	1/7/2003		10/2/2003
26/8/2003			11/10/2002	8/10/2002	21/7/2002			28/9/2002
					18/11/2002			21/9/2002
					29/10/2002			
					13/10/2003			

These data which are at Table 3.16 and Table 3.17.are prepeared according to boxplot graphics.We can make some comment according to graphics about normal distribution.If medium line of box is under center of y axis, skewness is positive. The medium line of box gives central tendency of data. With this knowledge, at Figure 3.72 mean is around of 400 mg/l, skewness is positive and close to '0' The data which are present under axe of box create abnormal distribution because of this they should be removed from data for to get normal distribution.

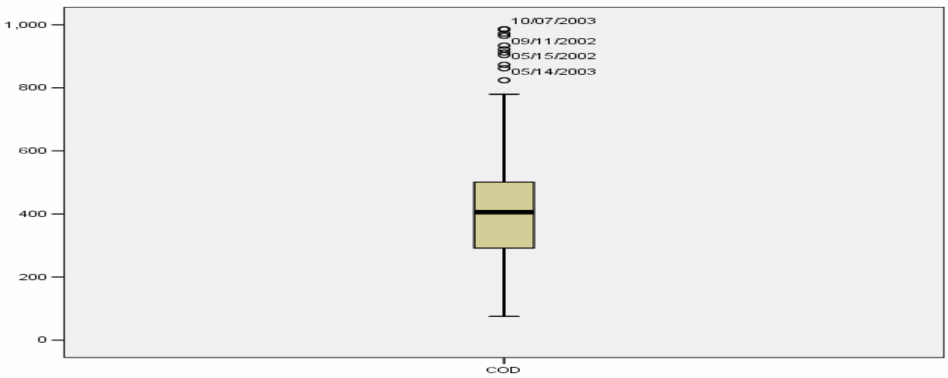


Figure 3.72 Boxplot graphic of IMWWTP' s influent COD values

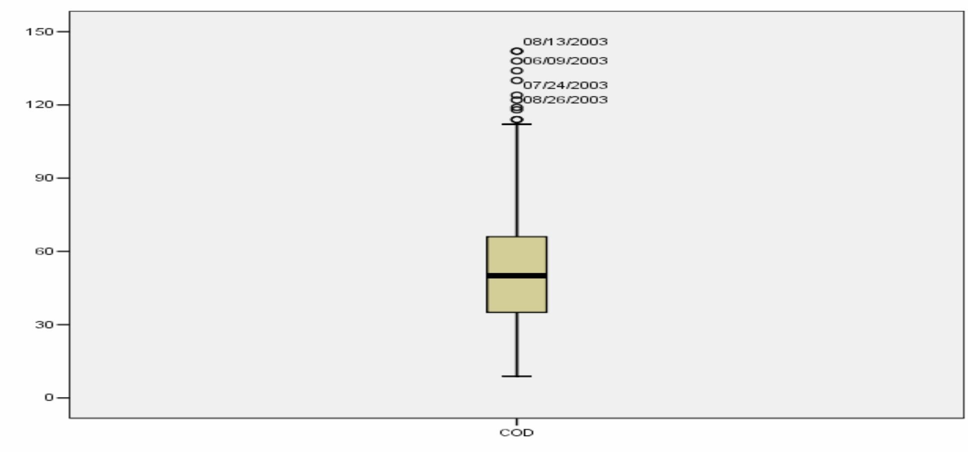


Figure 3.73 Boxplot graphic of IMWWTP' s effluent COD values

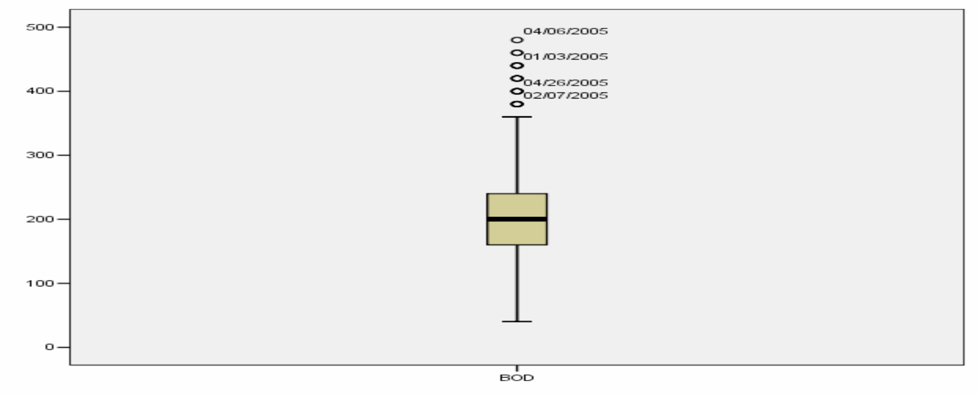


Figure 3.74 Boxplot graphic of IMWWTP' s influent BOD values

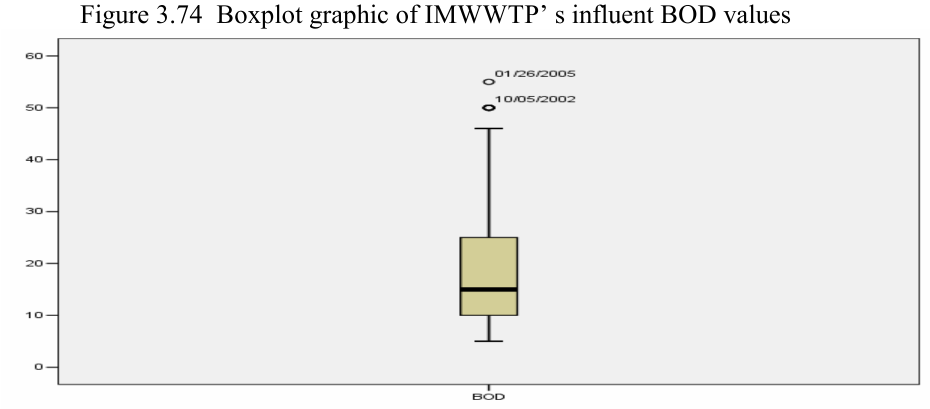


Figure 3.75 Boxplot graphic of IMWWTP' s effluent BOD values

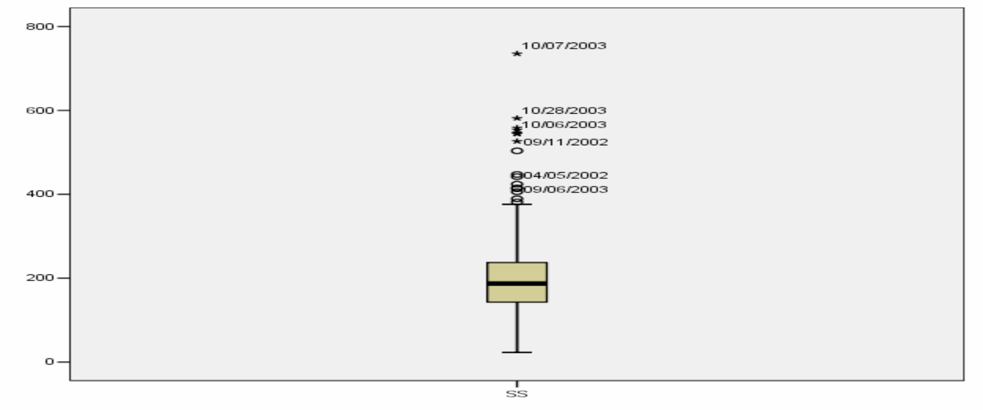


Figure 3.76 Boxplot graphic of IMWWTP' s influent SS values

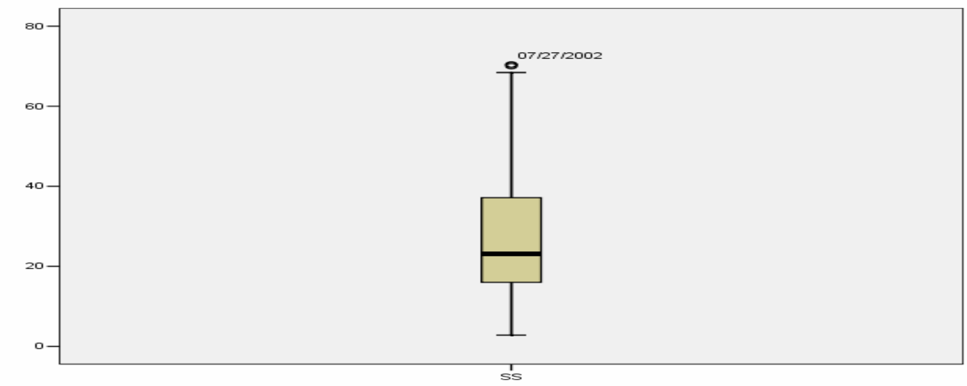


Figure 3.77 Boxplot graphic of IMWWTP' s effluent SS values

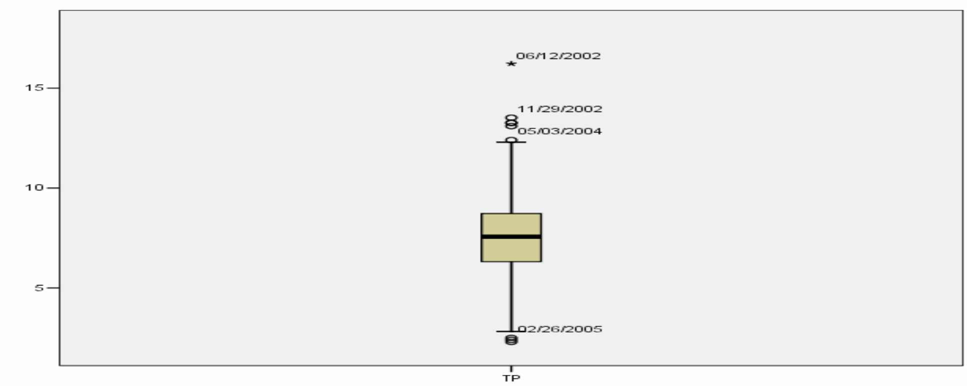


Figure 3.78 Boxplot graphic of IMWWTP' s influent TP values

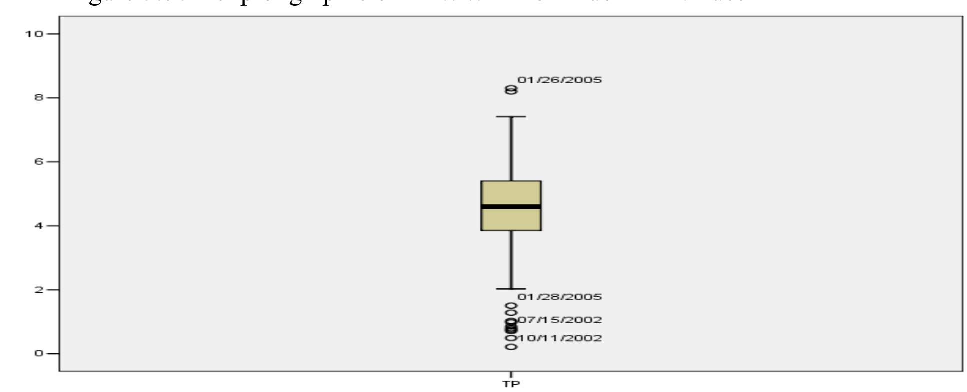


Figure 3.79 Boxplot graphic of IMWWTP' s effluent TP values

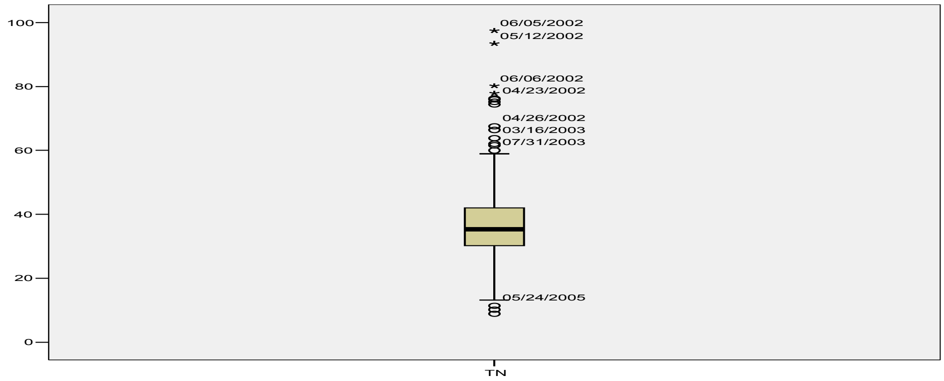


Figure 3.80 Boxplot graphic of IMWWTP' s influent TN values

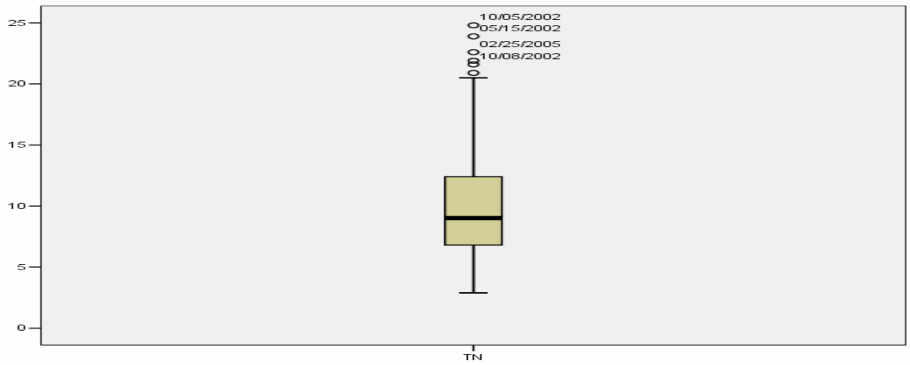


Figure 3.81 Boxplot graphic of IMWWTP' s effluent TN values

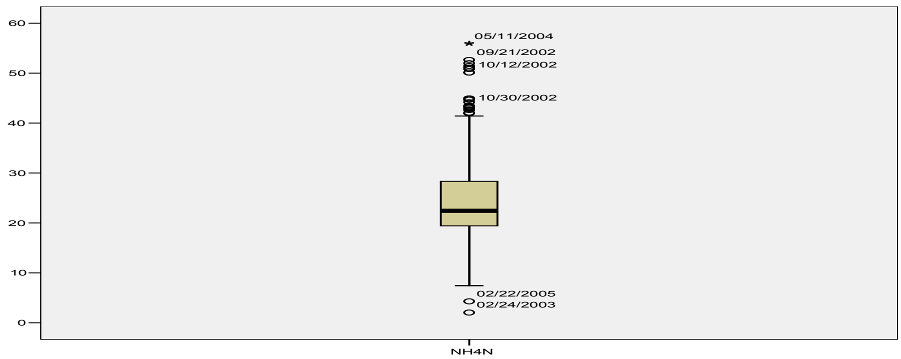


Figure 3.82 Boxplot graphic of IMWWTP' s influent NH_4N values

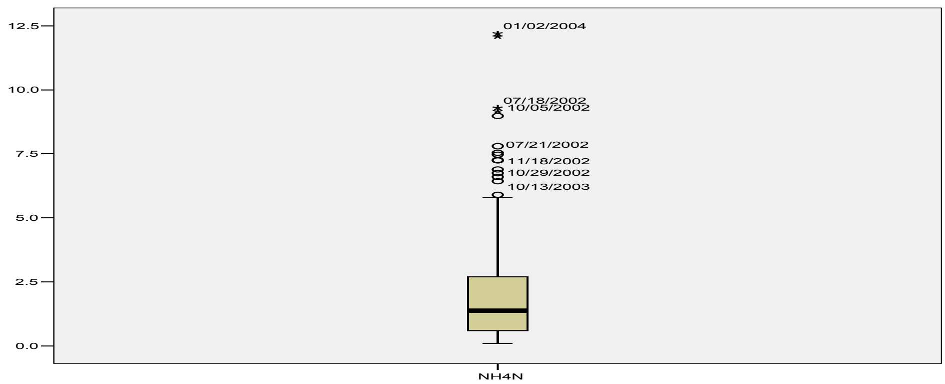


Figure 3.83 Boxplot graphic of IMWWTP' s effluent NH4N values

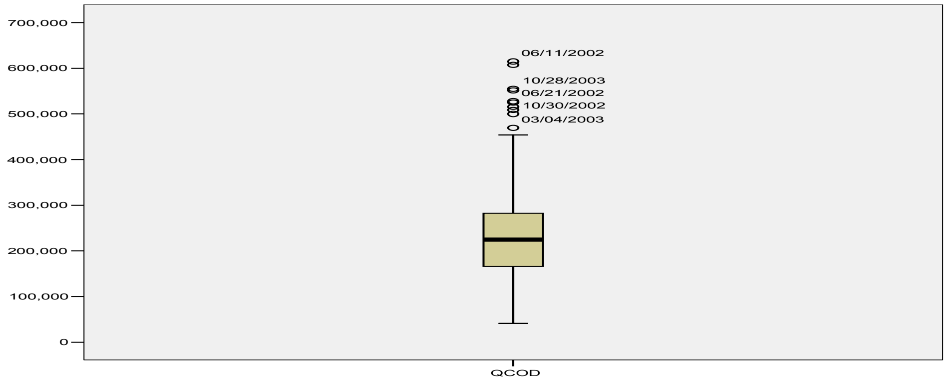


Figure 3.84 Boxplot graphic of IMWWTP' s influent QCOD values

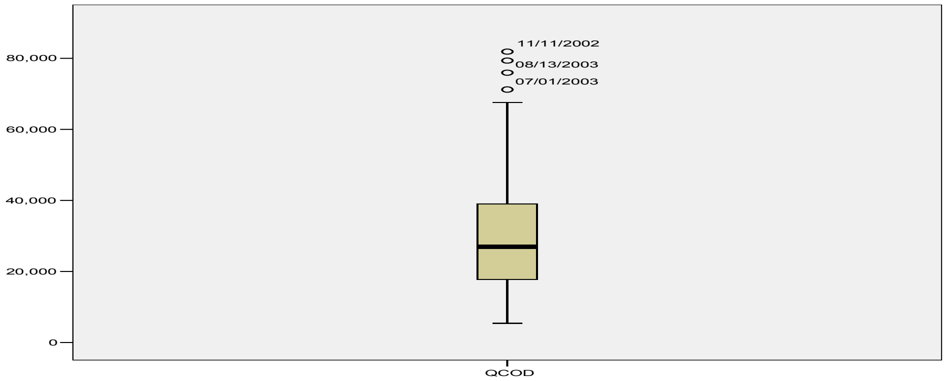


Figure 3.85 Boxplot graphic of IMWWTP' s effluent QCOD values

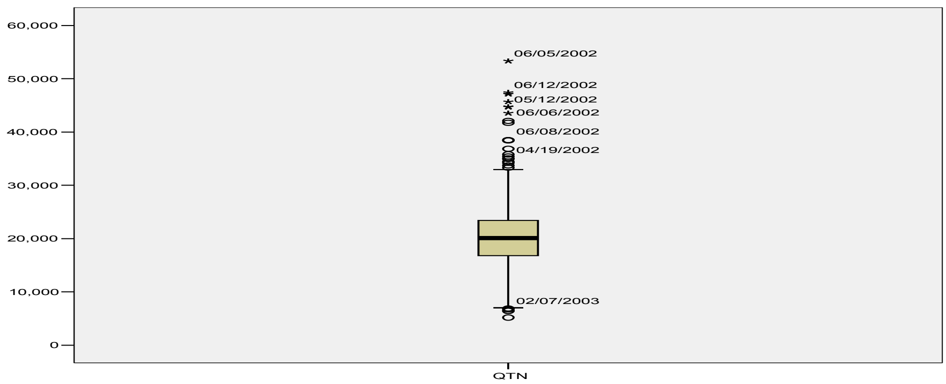


Figure 3.86 Boxplot graphic of IMWWTP' s influent QTN values

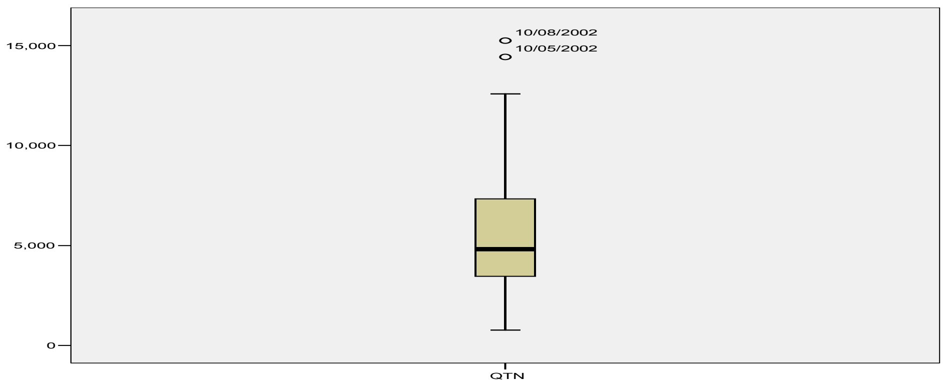


Figure 3.87 Boxplot graphic of IMWWTP' s effluent QTN values

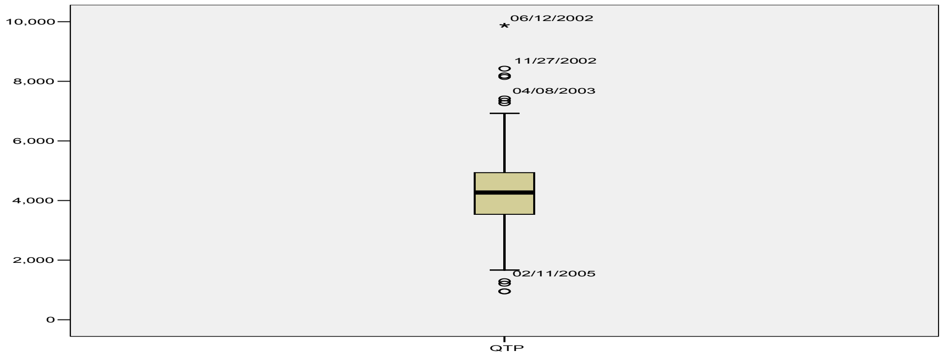


Figure 3.88 Boxplot graphic of IMWWTP' s inffluent QTP values

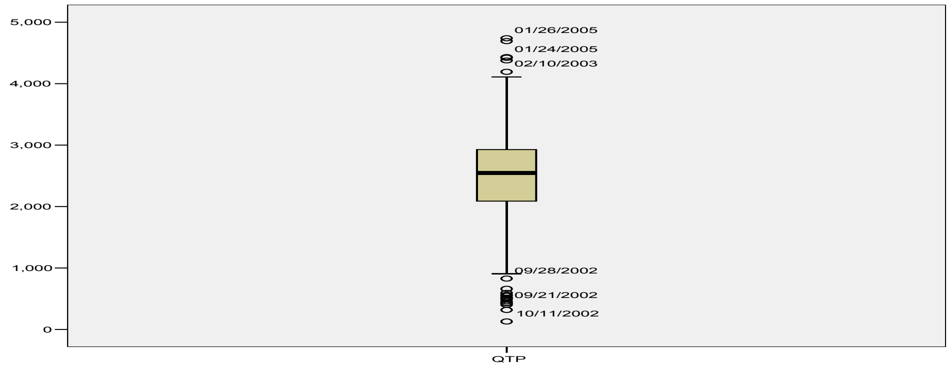


Figure 3.89 Boxplot graphic of IMWWTP' s effluent QTP values

3.8 Data Frequency analysis and descriptive statistics of GWWTP

Total number of GWWTP' s data is 1034. Considering the Table 3.17, According to Table 3.18, values are close to each other but there is also skewness. COD, BOD_5, SS, TP, TN, QCOD, QTN, QTP, $QBOD_5$'s' skewness is to right on histogram graphics because of mean>median>mode condition.

According to Table 3.19 minimum and maximum values are respectively: 30mg/l, and 864 mg/l for COD, 21.90 mg/l and 858 mg/l for BOD5, 19.2 mg/l and 768 mg/l for SS, 2.2 mg/l and 21.95 mg/l for TN, 0.36 mg/l and 8.60 mg/l for TP, 272.55 kg/day and 17191.87 kg/day for QCOD, 51.19 kg/day and 467.99 kg/day for QTN, 1.31 kg/day and 172.86 kg/day for QTP, 597.94 kg/day and 16852.84 kg/day for $QBOD_5$. Skewness coefficient is 1.552 and kurtosis coeffient is 3.672 for COD. 90 % of the COD values are lower than 365 mg/l. Skewness coefficients are generally around of 1.00 or higher than 1.00. For BOD_5 it's 2.38, for SS 2.00 , for TN 0.696, for TP 1.147, for FLOW 0.777, for QCOD 1.552, for QTN 0.607, for QTP 1.076, for $QBOD_5$ 2.41. Kurtosis coefficients are for COD 3.67, for BOD_5 7.35, for SS 5.90 , for TN 0.402, for TP 1.16, for QCOD 3.74, for QTN 1.108, for QTP 1.56, for QBOD5 7.94. All these results showed us that , GWWTP' s data are not normal distributed.

Table 3.17 Mean, median and mode values of GWWTP's influent data

	COD mg/l	BOD5 mg/l	SS mg/l	TN mg/l	TP mg/l	FLOW m^3/day	QCOD kg/day	QTN kg/day	QTP kg/day	QBOD5 Kg/day
Mean	222.238	129.8	155.25	9.613	2.50	21816.19	4609.621	199.9847	53.3467	2627.154
Median	202	86.85	125.4	8.95	2.1	20247	4122.8	190.8774	47.454	1900.402
Mode	207	75	92	7.6	2	27326	272.55	51.19	1.31	3348.12

Table 3.18 Mean, median and mode values of GWWTP's effluent data

	COD mg/l	BOD5 mg/l	SS mg/l	TN mg/l	TP mg/l	FLOW m^3/day	QCOD kg/day	QTN kg/day	QTP kg/day	QBOD5 Kg/day
Mean	52.42	11.07	24.581	2.60	0.97	21816.1	1089.4	55.38	21.22	225.02
Median	50.5	8.7	21	0.8	0.9	20247	1032.58	20.052	19.2087	189.4692
Mode	48	6.5	20	0.5	0.7	27326	540	2.69	35.1	163.96

Considering the Table 3.20, it can be said that, skewness values are greater than 1.00. Skewness values are respectively 1.06 for COD, 3.90 for BOD_5, 3.20 for SS, 0.96 for TN, 1.42 for TP, .777 for FLOW, 1.36 for QCOD, 1.28 for QTN, 0.789 for QTP, 3.61 for QBOD5. 90% of the COD values are lower than 84.38 mg/l, 90% of the BOD5 values are lower than 19.06 mg/l, 90% of SS values are lower than 38.88 mg/l, 90% of TN values are lower than 7.12 mg/l, 90% of the TP values are lower than 1.54 mg/l, 90% of FLOW values are lower than 29786 m^3/day, 90% of QCOD values are lower than 1655.21 kg/day, 90% of QTN values are lower than 149.69 kg/day, 90% of the QTP values are lower than 35.89 kg/day, 90% values of QBOD5 lower than 386.70 kg/day. The abnormal distribution is observed expressly QCOD, QTN, and QBOD5 data because mode values are considerably far from mean and median values. COD, BOD5, SS, TN, QCOD, QTN, and $QBOD_5$'s skewness are to right on histogram graphics.

Table 3.19 Influent data frequency analysis and descriptive statistics of GWWTP

Statistics

		COD mg/l	BOD mg/l	SS mg/l	TN mg/l	TP mg/l	FLOW m^3/day	QCOD kg/day	QTN kg/day	QTP kg/day	QBOD kg/day
N	Valid	790	702	812	748	251	1034	781	748	251	702
	Missing	245	333	223	287	784	1	254	287	784	333
Mean		222.2380	129.8674	155.2514	9.6132	2.5011	21816.19	4609.6214	199.9847	53.3467	2627.1541
Std. Error of Mean		4.24687	3.96253	3.73671	.11811	.09305	164.32474	81.90931	1.93856	1.79413	71.84217
Median		201.7857[a]	86.8000[a]	125.4000[a]	8.9313[a]	2.0813[a]	20247.00[a]	4122.8000[a]	190.8774[a]	47.4540[a]	1900.4023[a]
Mode		207.00	75.00	92.00[b]	7.60[b]	2.00	27326.00	272.55[b]	51.19[b]	1.31[b]	3348.12
Std. Deviation		119.36643	104.98835	106.47986	3.23013	1.47412	5284.005	2289.069	53.01891	28.42432	1903.479
Variance		14248.344	11022.554	11337.960	10.434	2.173	3E+007	5239835	2811.005	807.942	3623231
Skewness		1.552	2.388	2.052	.696	1.147	.777	1.552	.607	1.076	2.414
Std. Error of Skewness		.087	.092	.086	.089	.154	.076	.087	.089	.154	.092
Kurtosis		3.672	7.353	5.901	.402	1.160	.875	3.744	1.108	1.560	7.944
Std. Error of Kurtosis		.174	.184	.171	.179	.306	.152	.175	.179	.306	.184
Range		834.00	836.10	748.80	19.75	8.24	39758.00	16919.32	416.80	171.55	16254.90
Minimum		30.00	21.90	19.20	2.20	.36	1215.00	272.55	51.19	1.31	597.94
Maximum		864.00	858.00	768.00	21.95	8.60	40973.00	17191.87	467.99	172.86	16852.84
Sum		175568.00	91166.90	126064.17	7190.66	627.78	2E+007	3600114	149588.57	13390.03	1844262
Percentiles	10	95.8750[c]	53.8050[c]	58.5920[c]	6.0186[c]	1.0138[c]	16757.60[c]	2295.9146[c]	143.0091[c]	23.0256[c]	1241.5008[c]
	20	127.2000	64.0160	79.5733	7.1482	1.2170	17889.07	2873.3016	158.9240	29.6584	1426.5386
	25	140.3750	67.1429	86.2667	7.5172	1.3711	18354.00	3061.8345	163.9269	32.9049	1480.1760
	30	155.3333	70.3150	93.1100	7.7154	1.4658	18710.90	3282.7208	170.0169	35.8584	1540.9288
	40	180.4286	77.0600	108.8200	8.3274	1.7720	19311.47	3686.8289	179.3855	42.0026	1689.8790
	50	201.7857	86.8000	125.4000	8.9313	2.0813	20247.00	4122.8000	190.8774	47.4540	1900.4023
	60	220.8571	103.0933	146.4800	9.6548	2.5775	21448.00	4657.4382	205.2328	54.9617	2268.2020
	70	256.6667	134.8000	174.4480	10.7511	3.0283	23108.40	5253.3560	224.9689	62.4254	2752.9885
	75	272.6667	156.7500	188.0000	11.4733	3.2929	24412.00	5578.4400	234.4857	69.5362	3083.9040
	80	294.4286	180.1333	217.6960	12.3756	3.6950	26595.60	6003.0045	246.6055	74.7874	3475.3509
	90	365.0000	272.3000	283.8933	14.1262	4.4967	29786.30	7564.7984	270.2856	91.9183	5096.0810

a. Calculated from grouped data.

b. Multiple modes exist. The smallest value is shown

c. Percentiles are calculated from grouped data.

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Table 3.20 Effluent data frequency analysis and descriptive statistics of GWWTP

Statistics

		COD mg/l	BOD mg/l	SS mg/l	TN mg/l	TP mg/l	FLOW m^3/day	QCOD kg/day	QTN kg/day	QTP kg/day	QBOD kg/day
N	Valid	787	697	789	464	233	1034	787	464	233	697
	Missing	248	338	246	571	802	1	248	571	802	338
Mean		52.4265	11.0776	24.5814	2.6041	.9707	21816.19	1089.4055	55.3843	21.2247	225.0205
Std. Error of Mean		.87673	.33439	.63497	.12884	.03911	164.32474	17.16188	2.82335	.80680	5.93655
Median		50.4500[a]	8.8440[a]	21.0421[a]	.8212[a]	.9000[a]	20247.00[a]	1032.5398[a]	20.0520[a]	19.2087[a]	189.4692[a]
Mode		48.00	6.50	20.00	.50	.70[b]	27326.00	540.00	2.69[b]	35.10	163.96
Std. Deviation		24.59547	8.82825	17.83585	2.77521	.59704	5284.005	481.45103	60.81672	12.31523	156.72952
Variance		604.937	77.938	318.118	7.702	.356	3E+007	231795.1	3698.674	151.665	24564.142
Skewness		1.061	3.908	3.206	.958	1.421	.777	1.366	1.281	.789	3.614
Std. Error of Skewness		.087	.093	.087	.113	.159	.076	.087	.113	.159	.093
Kurtosis		2.424	25.221	14.048	-.525	2.973	.875	4.267	.798	.685	22.899
Std. Error of Kurtosis		.174	.185	.174	.226	.318	.152	.174	.226	.318	.185
Range		170.70	96.30	156.80	9.60	3.40	39758.00	3945.22	277.24	63.45	1692.78
Minimum		6.80	1.30	3.20	.20	.10	1215.00	29.16	2.69	.90	34.15
Maximum		177.50	97.60	160.00	9.80	3.50	40973.00	3974.38	279.93	64.35	1726.93
Sum		41259.63	7721.10	19394.70	1208.30	226.18	2E+007	857362.14	25698.33	4945.35	156839.31
Percentiles	10	24.3933[c]	4.2518[c]	10.0480[c]	.3414[c]	.3330[c]	16757.60[c]	559.2071[c]	7.0442[c]	7.0890[c]	95.9171[c]
	20	30.5900	5.5297	13.4827	.4544	.4876	17889.07	693.9666	10.1234	10.0072	121.8284
	25	33.3167	6.0397	15.3875	.5043	.5475	18354.00	753.4917	11.0594	11.6538	130.8092
	30	36.0733	6.4886	16.9486	.5542	.6113	18710.90	821.1751	12.5381	13.5847	140.8521
	40	44.5933	7.5550	19.0141	.6688	.7616	19311.47	929.7911	15.2867	16.4143	162.4030
	50	50.4500	8.8440	21.0421	.8212	.9000	20247.00	1032.5398	20.0520	19.2087	189.4692
	60	55.5933	10.4070	23.3486	1.5760	1.0440	21448.00	1147.9518	36.4606	22.8674	216.5801
	70	61.3029	12.4084	25.7097	4.1920	1.1803	23108.40	1265.7824	82.2189	27.1532	253.9341
	75	65.5500	13.5111	27.1417	4.9429	1.2250	24412.00	1342.1156	97.4121	28.8684	274.1447
	80	71.1050	14.7246	29.1880	5.6033	1.3060	26595.60	1413.6046	110.1515	30.5954	301.1371
	90	84.3800	19.0600	38.8800	7.1200	1.5486	29786.30	1655.2196	149.6920	35.8958	386.7018

a. Calculated from grouped data.

b. Multiple modes exist. The smallest value is shown

c. Percentiles are calculated from grouped data.

3.9 Histogram of Guneybatı WWTP's data

Histograms are another way of checking, whether data have a normal distribution or not.

According to Figure 3.90, COD values of GWWTP's influent data have a low frequency over 600 mg/l, repeated 13 times with a percentage of 1.3. BOD values of GWWTP's influent data also have a low frequency between 600-858 mg/l with a repeat of 4 times and percentage of 0.4 (see Figure 3.95). FLOW reached once over 40000 m^3/day which gives a percentage of less than 1 (see Figure 3.100). QCOD values repeated twice between 15000-20000 kg/day (see Figure 3.102). QTN values repeated once over 400 kg/day (see Figure 3.104).

COD values of GWWTP's effluent data repeated 13 times between 150-180 mg/l (see Figure 3.91), BOD values repeated 9 times between 40-97.60 mg/l (see Figure 3.93), SS values repeated 10 times between 100-160mg/l (see Figure 3.95), QBOD values repeated 5 times between 1000-1700 mg/l (see Figure 3.109). As shown on TN, QTN and QTP histograms for GWWTP' s effluent data, there are significant frequency deviations (see Figure 3.99-3.105-3.107).

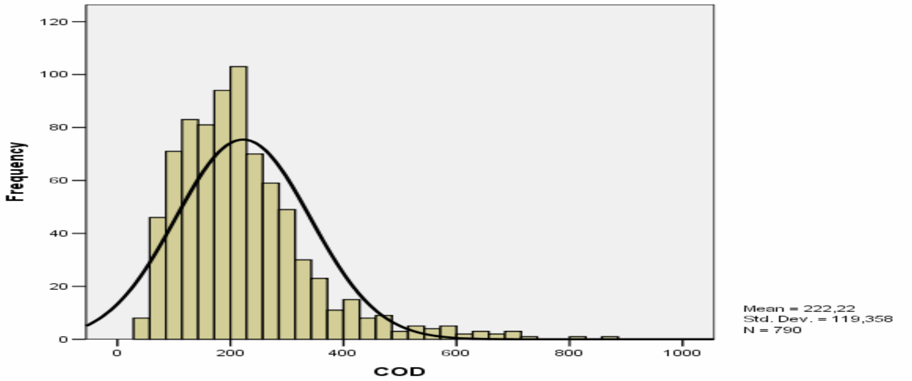


Figure 3.90 GWWTP frequency graphic of COD in influent data

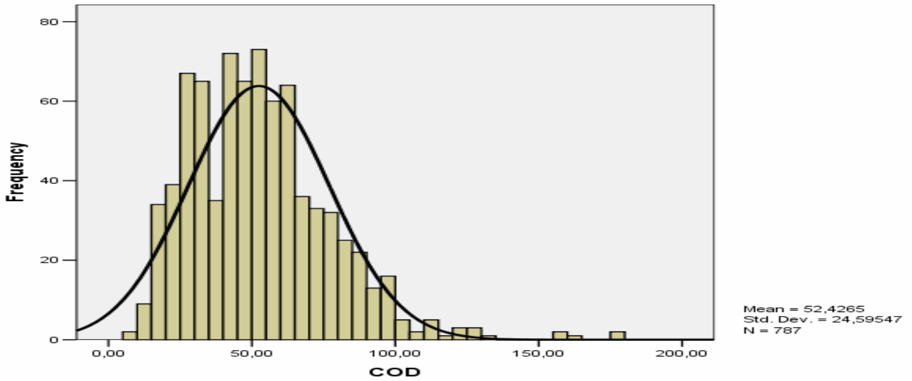


Figure 3.91 GWWTP frequency graphic of COD in effluent data

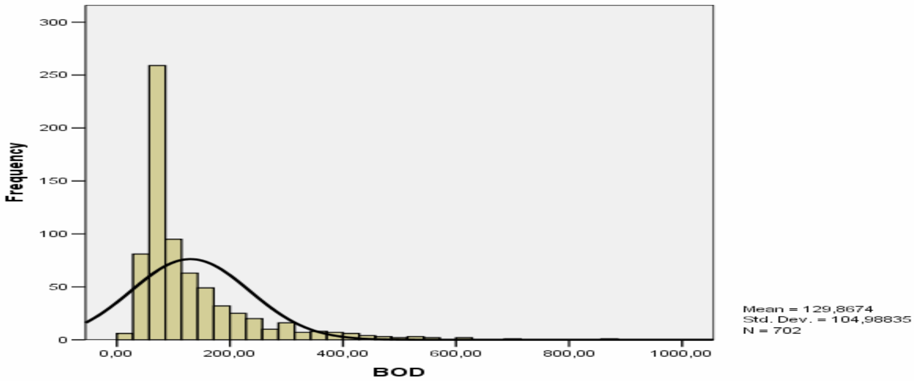


Figure 3.92 GWWTP frequency graphic of BOD in influent data

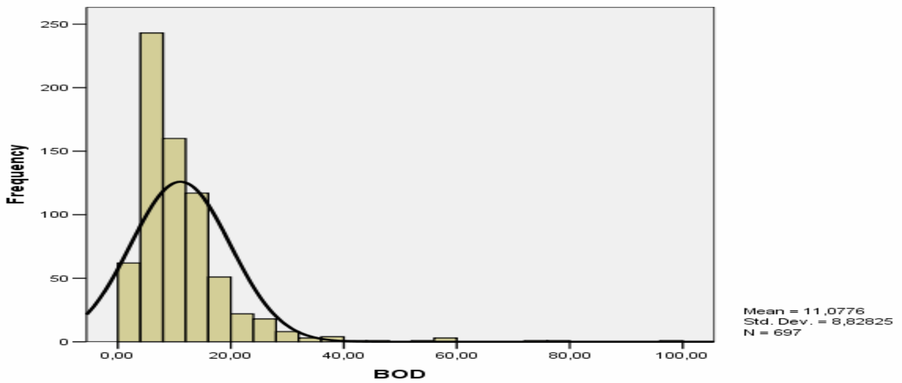


Figure 3.93 GWWTP frequency graphic of BOD in effluent data

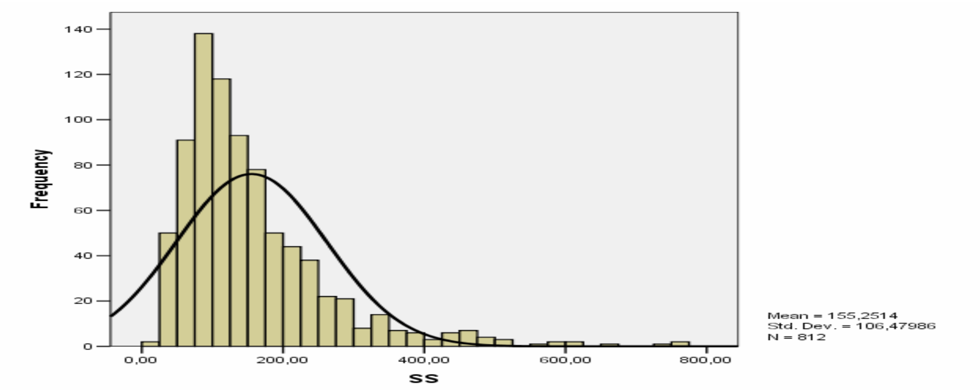


Figure 3.94 GWWTP frequency graphic of SS in influent data

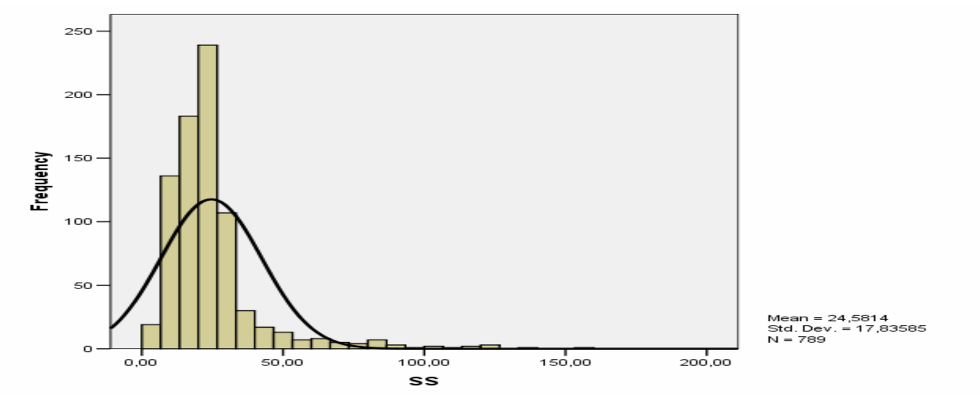


Figure 3.95 GWWTP frequency graphic of SS in effluent data

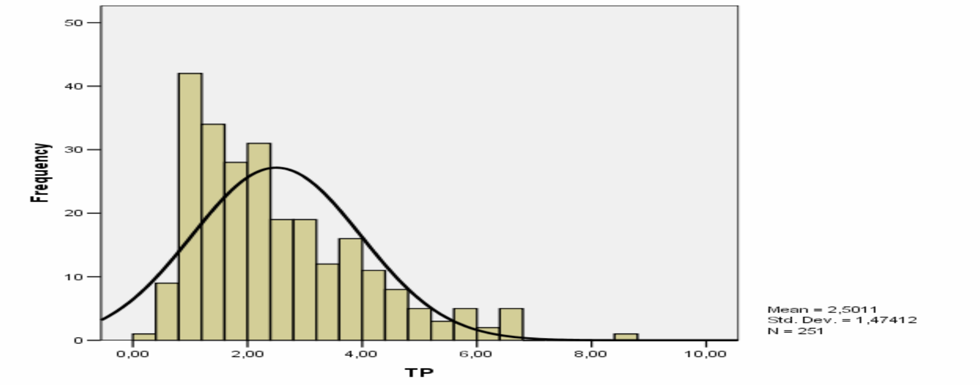


Figure 3.96 GWWTP frequency graphic of TP in influent data

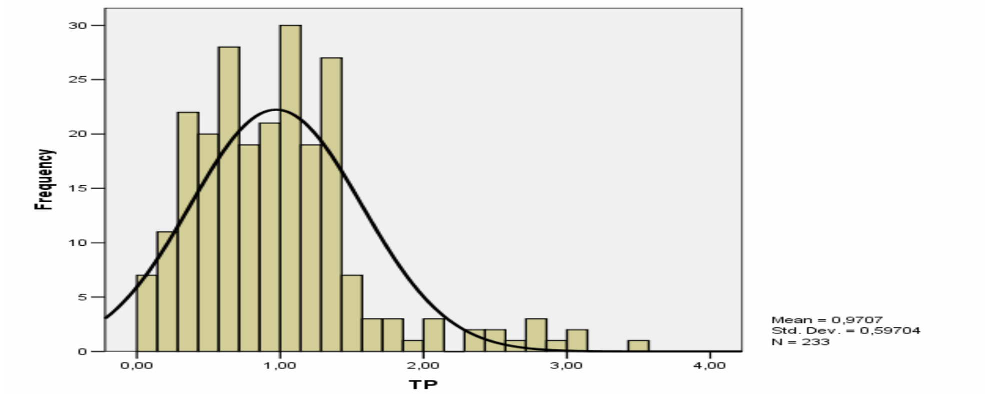


Figure 3.97 GWWTP frequency graphic of TP in effluent data

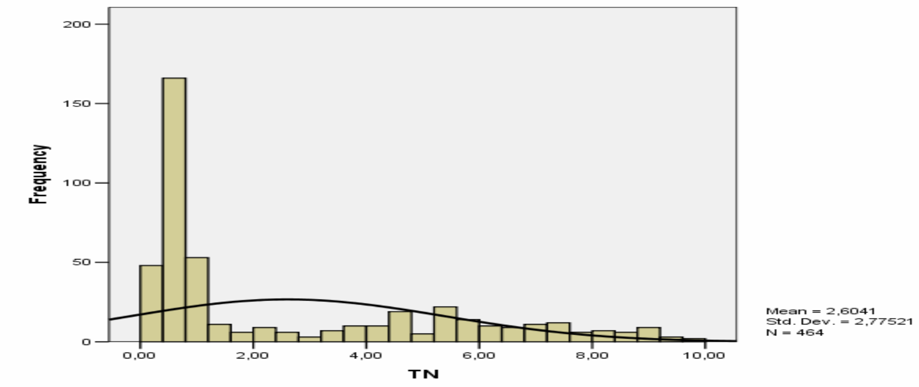


Figure 3.98 GWWTP frequency graphic of TN in influent data

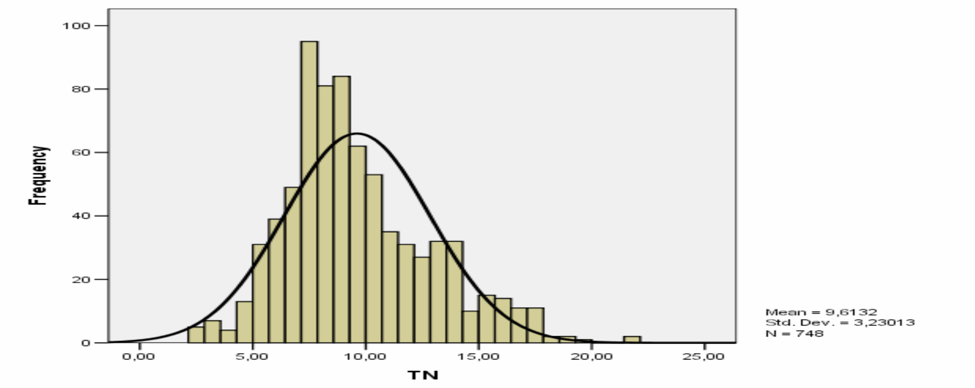


Figure 3.99 GWWTP frequency graphic of TN in effluent data

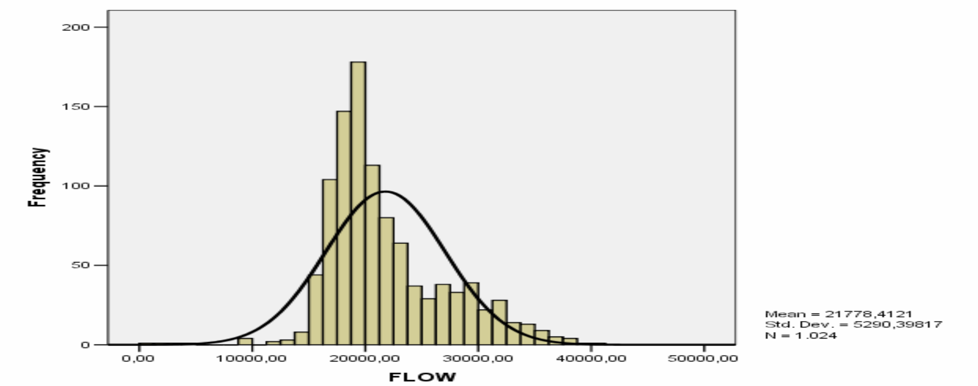


Figure 3.100 GWWTP frequency graphic of FLOW in influent data

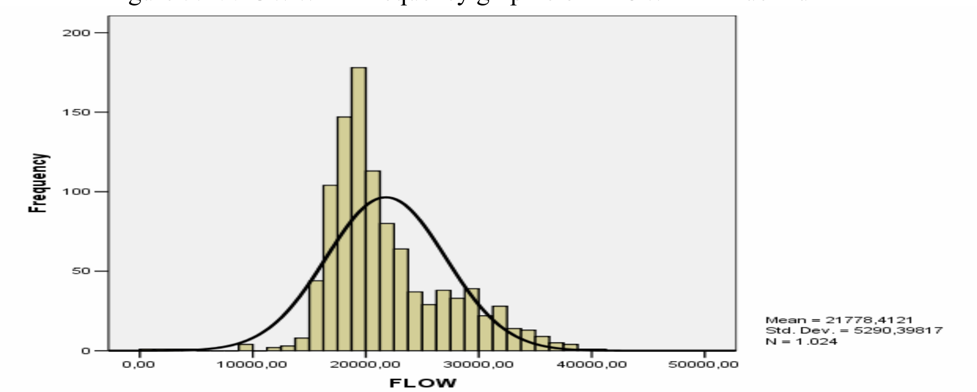


Figure 3.101 GWWTP frequency graphic of FLOW in effluent data

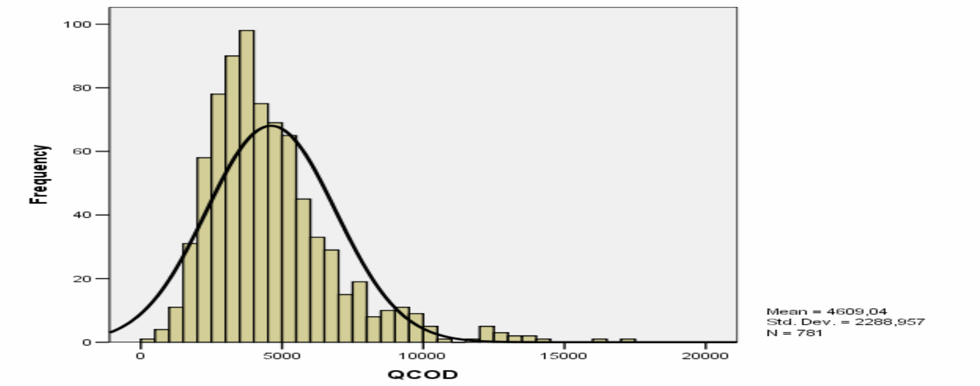


Figure 3.102GWWTP frequency graphic of QCOD in influent data

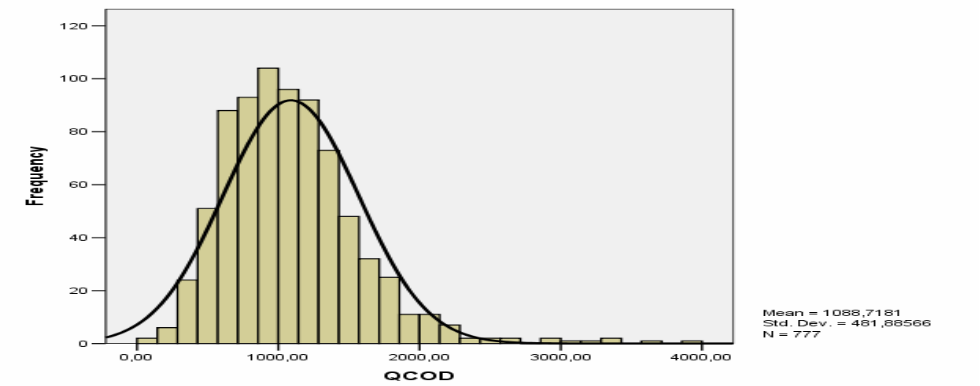


Figure 3.103 GWWTP frequency graphic of QCOD in effluent data

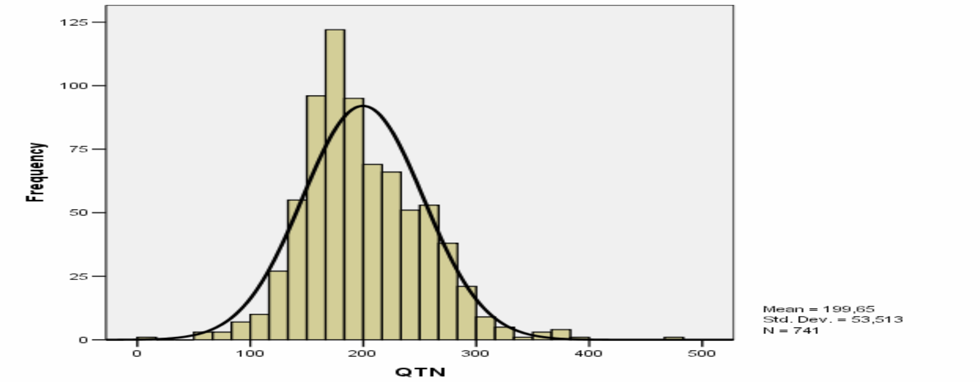


Figure 3.104 GWWTP frequency graphic of QTN in influent data

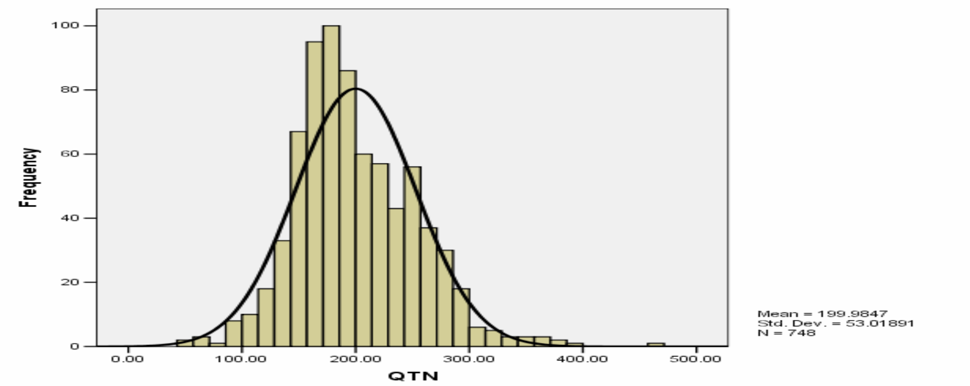


Figure 3.105 GWWTP frequency graphic of QTN in effluent data

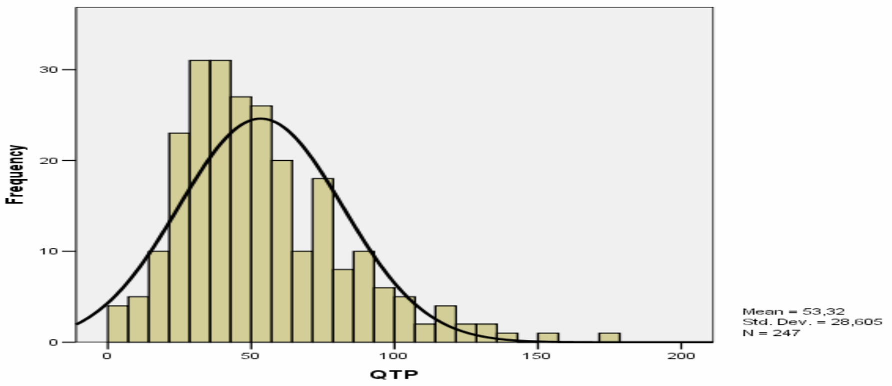


Figure 3.106 GWWTP frequency graphic of QTP in influent data

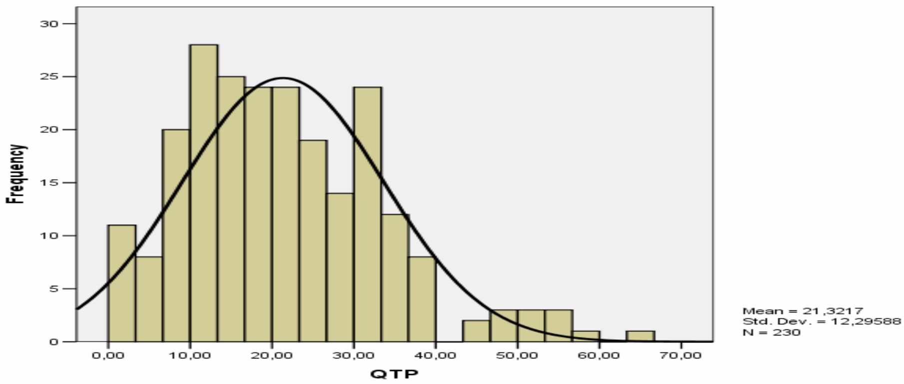


Figure 3.107 GWWTP frequency graphic of QTP in effluent data

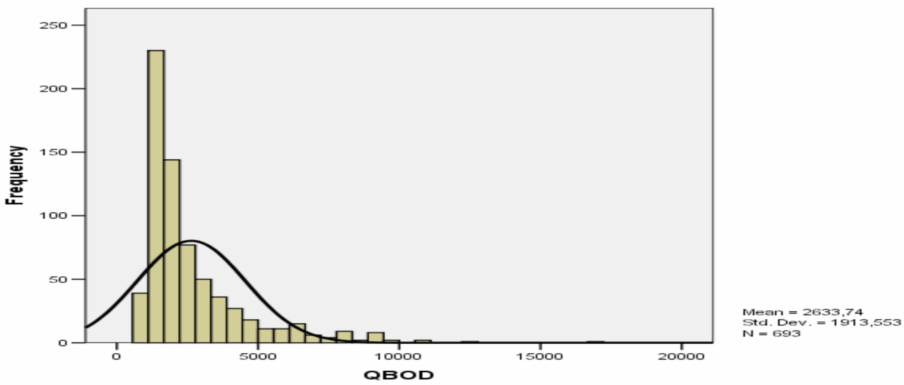


Figure 3.108 GWWTP frequency graphic of QBOD in influent data

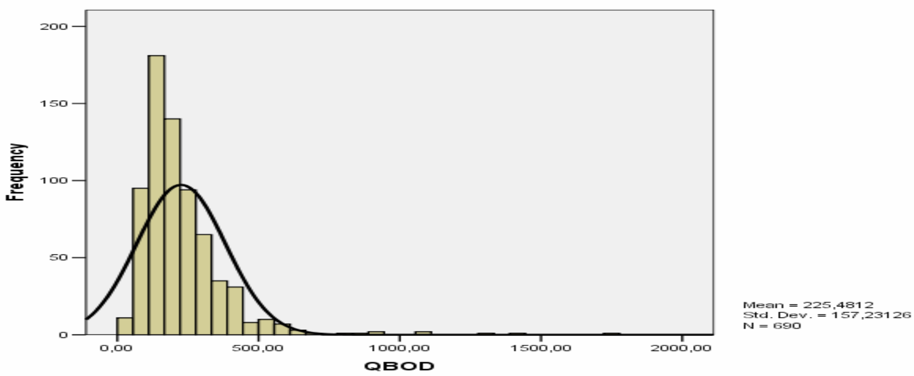


Figure 3.109 GWWTP frequency graphic of QBOD in effluent data

3.10 Homogeneity analysis of GWWTP's data

Some of data are observed which are not homogeneous and their frequency is also low. Therefore Homogeneity analysis is applied to the data.

As it is seen in figures 3.110-3.111-3.120-3.121-3.122-3.124-3.125, first group is far from the other groups on symmetrical graphics. Therefore first group creates abnormal distribution during data analysis. For this reason homogeneity analysis are used and heterogeneous data are established.

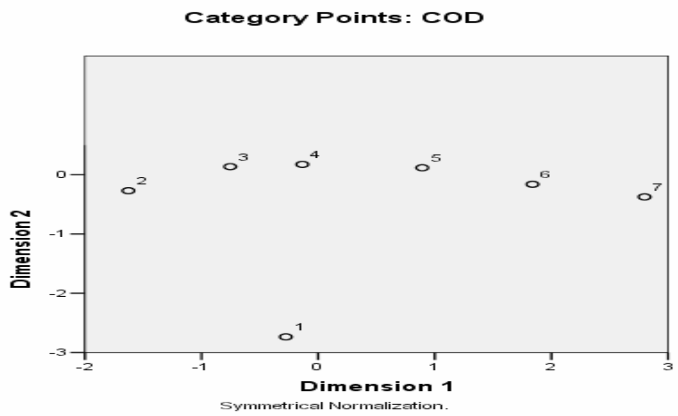


Figure 3.110 Symmetrical normalization of GWWTP's influent COD data

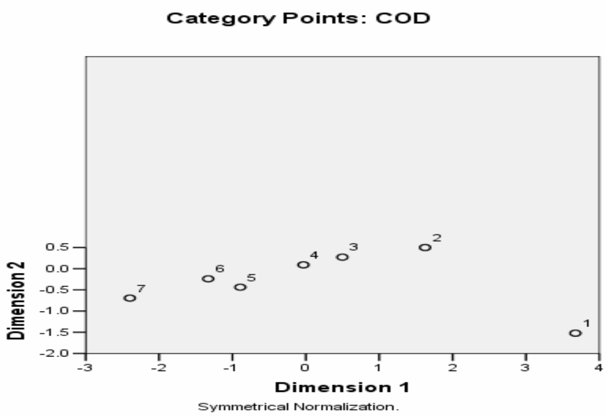


Figure 3.111 Symmetrical normalization of GWWTP's effluent COD data

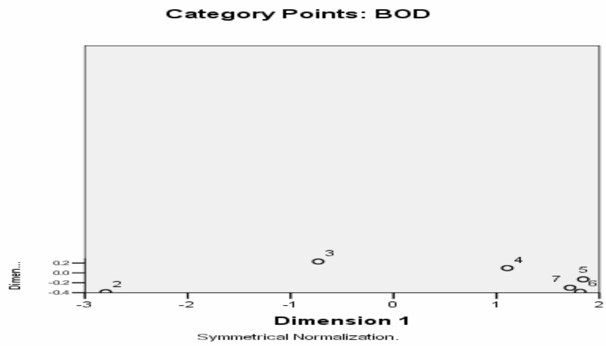


Figure 3.112 Symmetrical normalization of GWWTP's influent BOD data

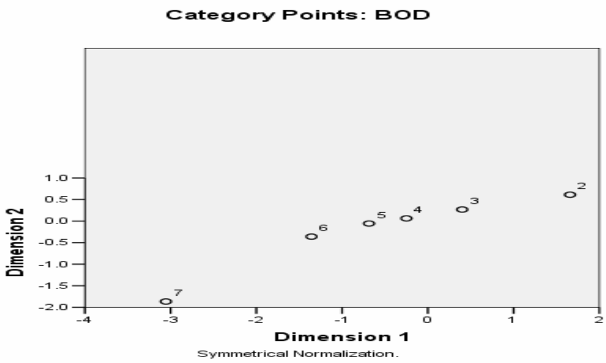


Figure 3.113 Symmetrical normalization of GWWTP's effluent BOD data

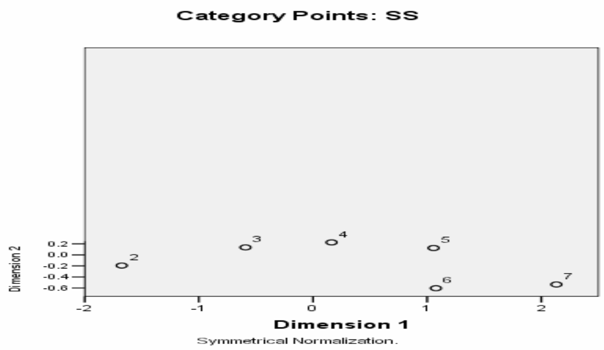


Figure 3.114 Symmetrical normalization of GWWTP's influent SS data

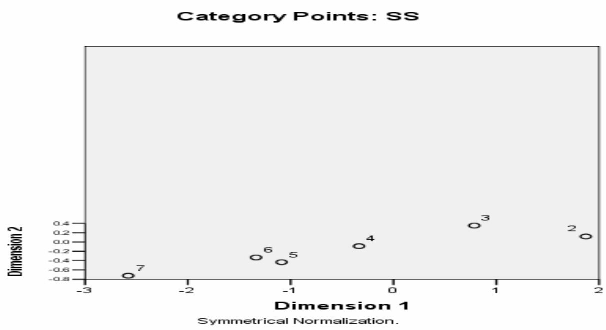


Figure 3.115 Symmetrical normalization of GWWTP's effluent SS data

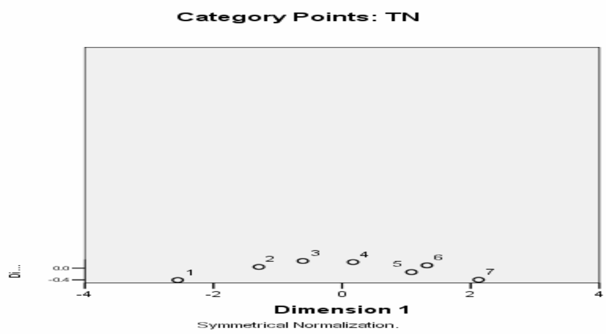


Figure 3.116 Symmetrical normalization of GWWTP's influent TN data

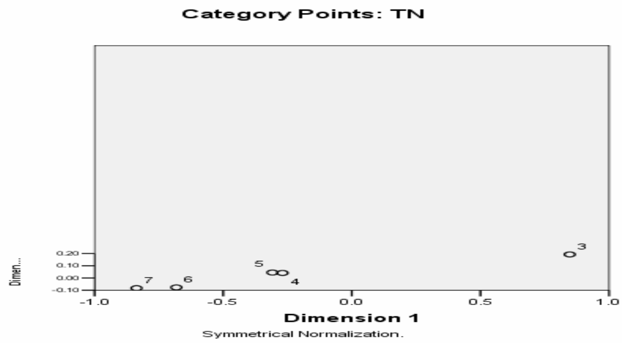


Figure 3.117 Symmetrical normalization of GWWTP's effluent TN data

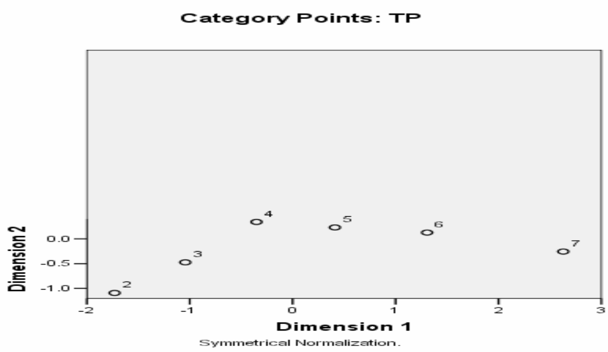


Figure 3.118 Symmetrical normalization of GWWTP's influent TP data

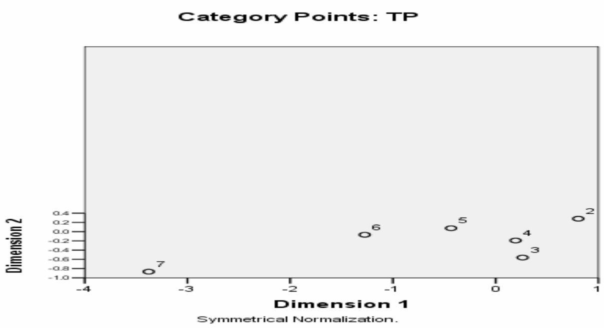


Figure 3.119 Symmetrical normalization of GWWTP's effluent TP data

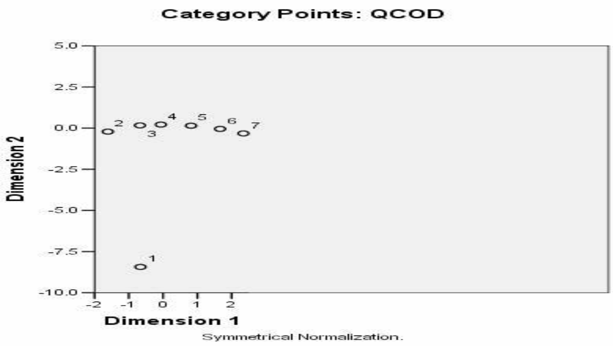


Figure 3.120 Symmetrical normalization of GWWTP's influent QCOD data

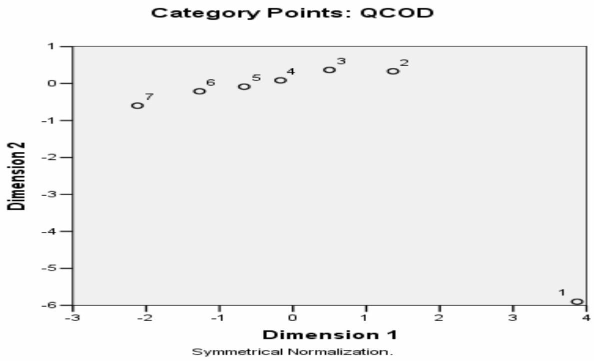


Figure 3.121 Symmetrical normalization of GWWTP's effluent QCOD data

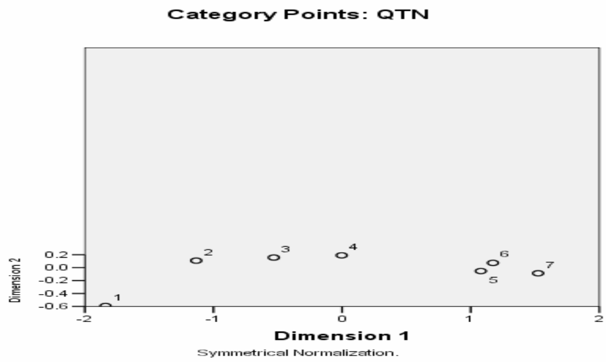


Figure 3.122 Symmetrical normalization of GWWTP's influent QTN data

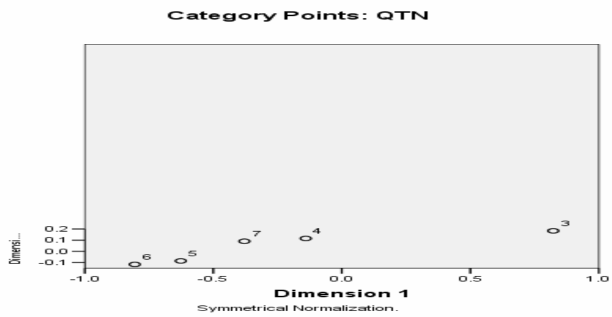


Figure 3.123 Symmetrical normalization of GWWTP's effluent QTN data

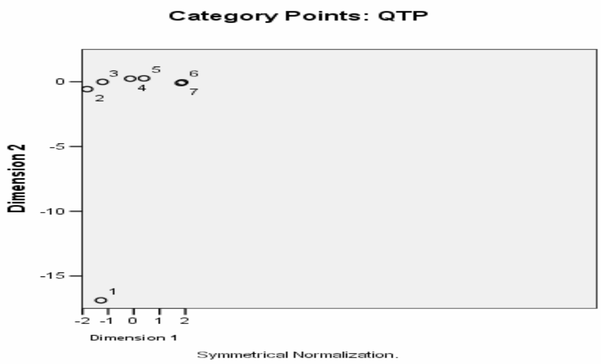


Figure 3.124 Symmetrical normalization of GWWTP's influent QTP data

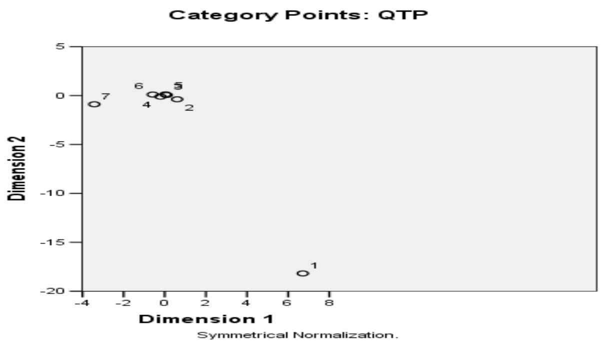


Figure 3.125 Symmetrical normalization of GWWTP's effluent QTP data

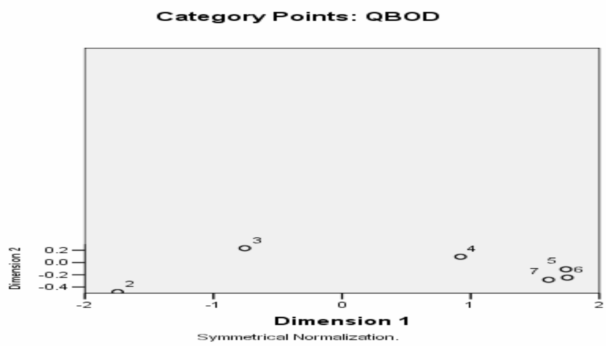


Figure 3.126 Symmetrical normalization of GWWTP's influent QBOD data

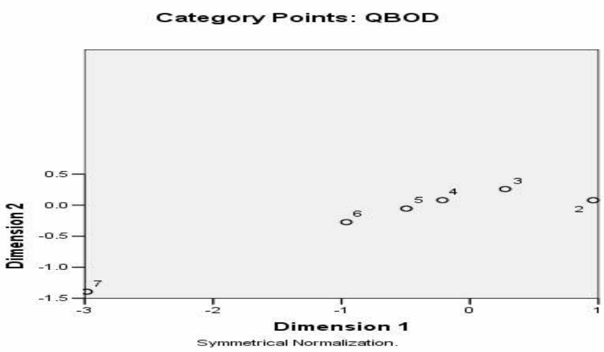


Figure 3.127 Symmetrical normalization of GWWTP's effluent QBOD data

3.11 Correlation Analysis of GWWTP's data

In this study, the correlation analysis are used for 6 variables. When Table 3.22 is inspected, COD-SS association can be seen with a correlation coefficient of 0.763, $p<0.05$. This shows that COD-SS correlation is strong .Similar strong associations are found between COD-BOD (0.527), $p<0.05$, COD-TN (0.570), $p<0.05$, COD-TP (0.711) , $p<0.05$ according to spearman correlation. In this case, we can say that there is a relation between COD-TP, COD-BOD, COD-TN.

Table 3.22 Correlation table of GWWTP's influent data

			COD	BOD	SS	TN	TP	FLOW
Spearman's rho	COD	Correlation coefficient	1.00	0.53	0.76	0.57	0.71	-0.37
		Sig. (2-tailed)		0.00	0.00	0.00	0.00	0.00
		N	790.0	669.0	774.0	711.00	239.00	790.00
	BOD	Correlation coefficient	0.53	1.00	0.46	0.52	0.63	-0.36
		Sig. (2-tailed)	0.00		0.00	0.00	0.00	0.00
		N	669.0	702.0	690.0	665.00	168.00	702.00
	SS	Correlation coefficient	0.76	0.46	1.00	0.26	0.53	-0.18
		Sig. (2-tailed)	0.00	0.00		0.00	0.00	0.00
		N	774.0	690.0	812.0	728.00	242.00	812.00
	TN	Correlation coefficient	0.57	0.52	0.26	1.00	0.73	-0.58
		Sig. (2-tailed)	0.00	0.00	0.00		0.00	0.00
		N	711.0	665.0	728.0	748.00	199.00	748.00
	TP	Correlation coefficient	0.71	0.63	0.53	0.73	1.00	-0.35
		Sig. (2-tailed)	0.00	0.00	0.00	0.00		0.00
		N	239.0	168.0	242.0	199.00	251.00	251.00
	FLOW	Correlation coefficient	-0.37	-0.36	-0.18	-0.58	-0.35	1.00
		Sig. (2-tailed)	0.00	0.00	0.00	0.00	0.00	
		N	790.0	702.0	812.0	748.00	251.00	1,034.

** Correlation is significant at the 0.01 level (2-tailed).

When the Table 3.23 is checked, strong associations are seen between COD-BOD (0.323), $p<0.05$, COD-SS (0.584), $p<0.05$, COD-TN (0.245), $p<0.05$, COD-TP (0.338), $p<0.05$, SS-BOD (0.317), $p<0.05$, SS-TP (0.450), $p<0.05$, TP-TN (0.267), $p<0.05$.

Table 3.23 Correlation table of GWWTP's effluent data

Spearman		COD	BOD	SS	TN	TP	FLOW
COD	Correlation	1.00	0.32	0.58	0.25	0.34	-0.40
	Sig. (2-tailed)		0.00	0.00	0.00	0.00	0.00
	N	787.00	665.00	758.00	448.00	218.00	787.00
BOD	Correlation	0.32	1.00	0.32	0.19	0.15	-0.33
	Sig. (2-tailed)	0.00		0.00	0.00	0.05	0.00
	N	665.00	697.00	660.00	393.00	173.00	697.00
SS	Correlation	0.58	0.32	1.00	0.20	0.45	-0.17
	Sig. (2-tailed)	0.00	0.00		0.00	0.00	0.00
	N	758.00	660.00	789.00	450.00	224.00	789.00
TN	Correlation	0.25	0.19	0.20	1.00	0.27	-0.15
	Sig. (2-tailed)	0.00	0.00	0.00		0.00	0.00
	N	448.00	393.00	450.00	464.00	155.00	464.00
TP	Correlation	0.34	0.15	0.45	0.27	1.00	-0.19
	Sig. (2-tailed)	0.00	0.05	0.00	0.00		0.00
	N	218.00	173.00	224.00	155.00	233.00	233.00
FLOW	Correlation	-0.40	-0.33	-0.17	-0.15	-0.19	1.00
	Sig. (2-tailed)	0.00	0.00	0.00	0.00	0.00	
	N	787.00	697.00	789.00	464.00	233.00	1,034.00

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

3.12 Scatter graphics of inluent and effluent data of GWWTP

Scatter graphics are prepeared for 1035 data and 10 variables of GMWWTP' s influent and effluent data. And linear association are obtained at Figure 3.127 (influent data of COD-BOD), at Figure 3.128 (effluent data of COD-BOD), at Figure 3.129 (influent data of COD-SS), at Figure 3.130 (effluent data of COD-SS), at Figure 3.131(influent data of COD-TN), at Figure 3.133 (influent data of COD-TP), at Figure 3.137(influent data of TP-SS), at Figure 3.138 (effluent data of TP-SS), at Figure 3.139(influent data of TP-BOD), . At figure 3.141, at figure 3.142, at figure 3.143, at figure 3.144 and at figure 3.145 we don't observe any liner association between GWWTP's influent and effluent QCOD, QBOD, QSS, QTN, and QTP.

The correlation coefficients of GWWTP's influent data on Table 3.25 and effluent data on Table 3.26 are given. There are relationship for COD-BOD, COD-SS, COD-TN, COD-TP, TP-SS, TP-BOD. On Table 3.27 IQTN-EQTN and IQTP-EQTP's $p>0.05$.Which means there is no any significant statistically and also there is no any relationship between these variables.

Table 3.25 Correlation coefficients of GWWTP's influent data

	COD-BOD	COD-SS	COD-TN	COD-TP	TP-SS	TP-BOD
Correlation coefficient	0.527	0.763	0.570	0.711	0.533	0.633
sig.	0.000	0.000	0.000	0.00	0.000	0.000

Table 3.26 Correlation coefficients of GWWTP's effluent data

	COD-BOD	COD-SS	COD-TN	COD-TP	TP-SS	TP-BOD
Correlation coefficient	0.323	0.584	0.245	0.338	0.317	0.153
sig.	0.000	0.000	0.000	0.000	0.000	0.045

Table 3.27 Correlation coefficients of GWWTP's influent -effluent data

	IQCOD-EQBOD	IQBOD-EQBOD	IQSS-EQSS	IQTN-EQTN	IQTP-EQTP
Correlation coef.	0,158	0,055	0,113	-0,005	0,09
sig.	0.000	0,038	0.000	0,88	0,056

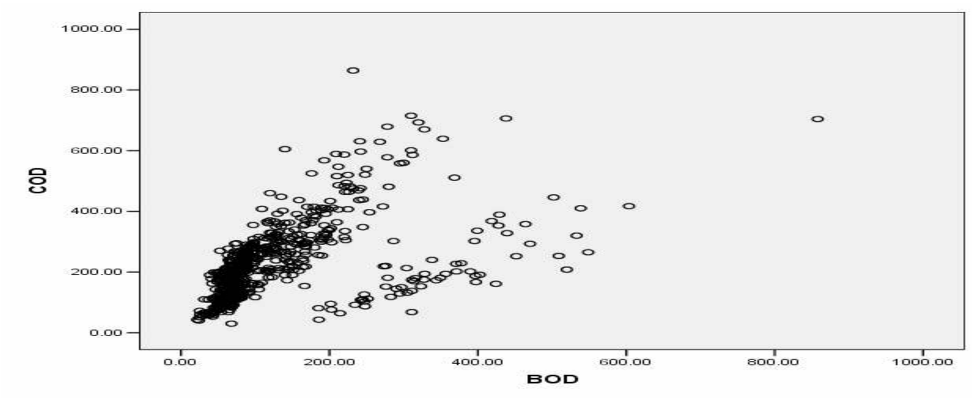


Figure 3.127 Scatter graphic of GWWTP' s influent COD-BOD data

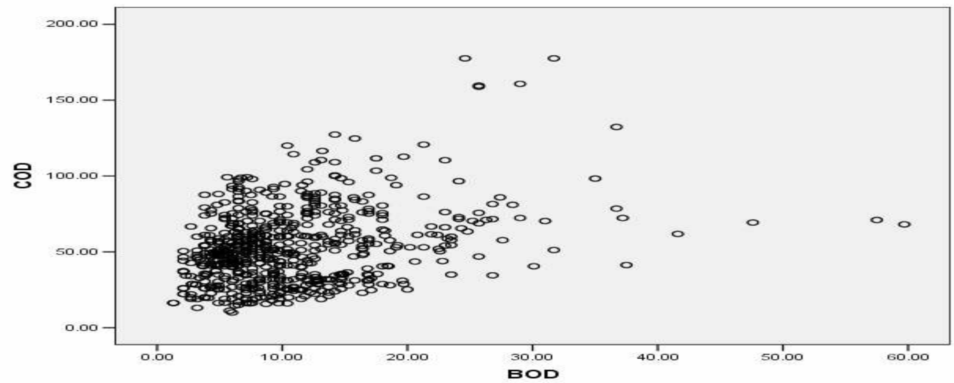


Figure 3.128 Scatter graphic of Guneybati effluent COD-BOD data

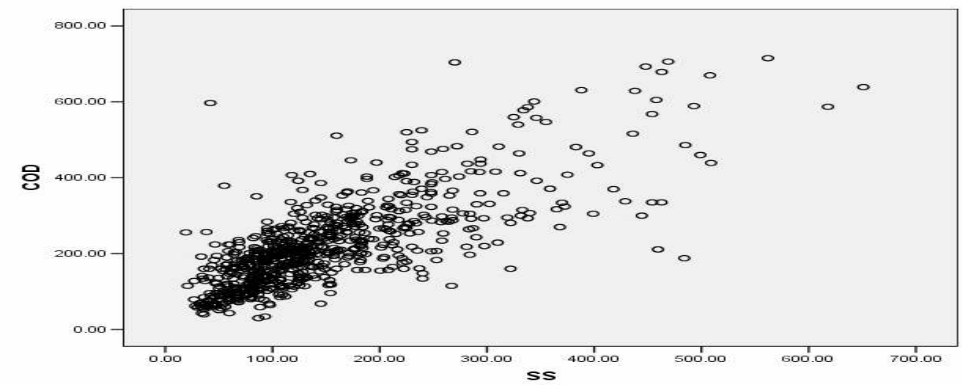


Figure 3.129 Scatter graphic of Guneybati influent COD-SS data

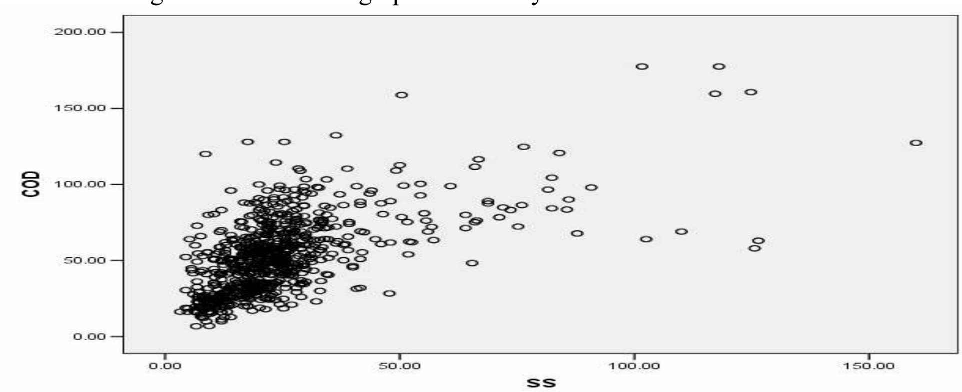


Figure 3.130 Scatter graphic of GWWTP effluent COD-SS data

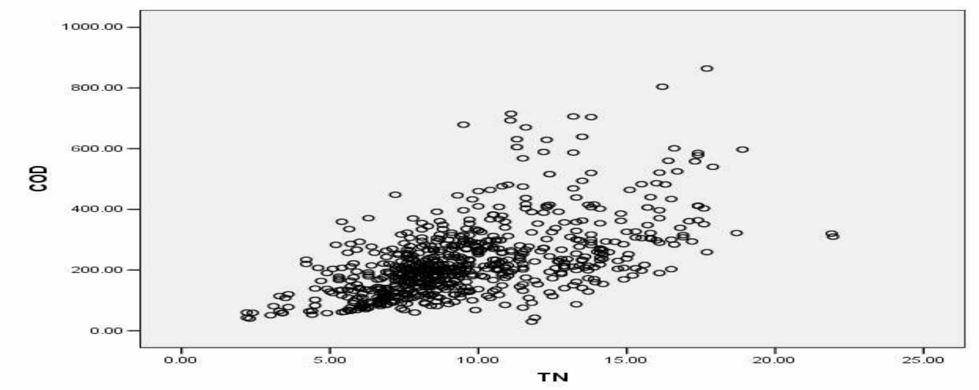


Figure 3.131 Scatter graphic of Guneybati influent COD-TN data

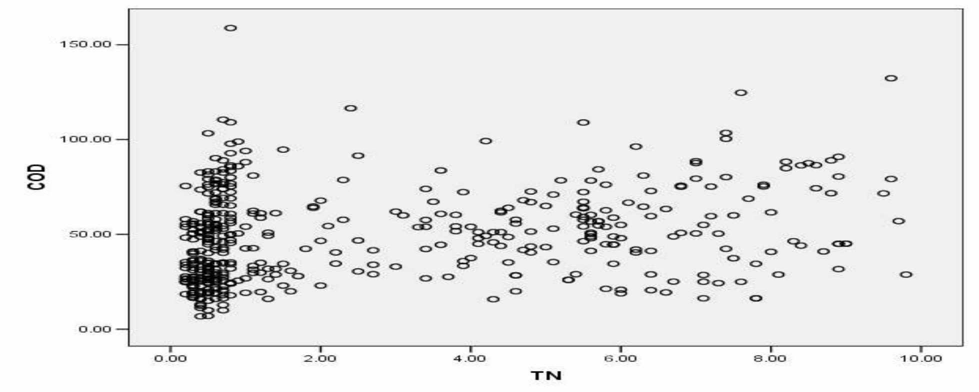


Figure 3.132 Scatter graphic of Guneybati effluent COD-TN data

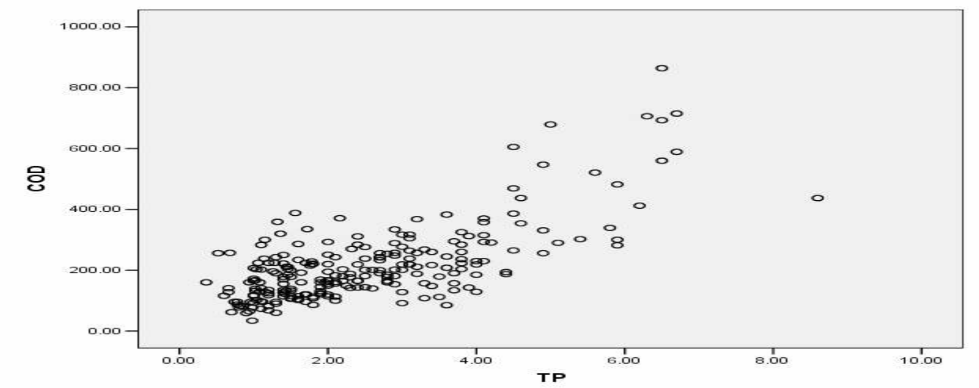


Figure 3.133 Scatter graphic of Guneybati influent COD-TP data

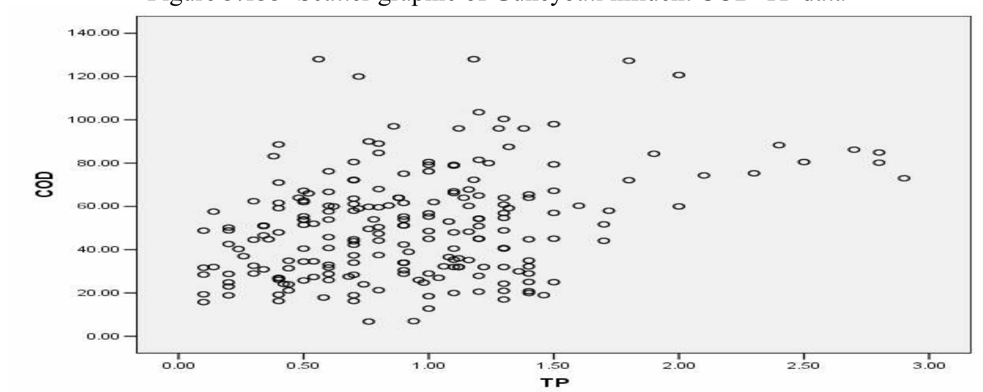


Figure 3.134 Scatter graphic of Guneybati effluent COD-TP data

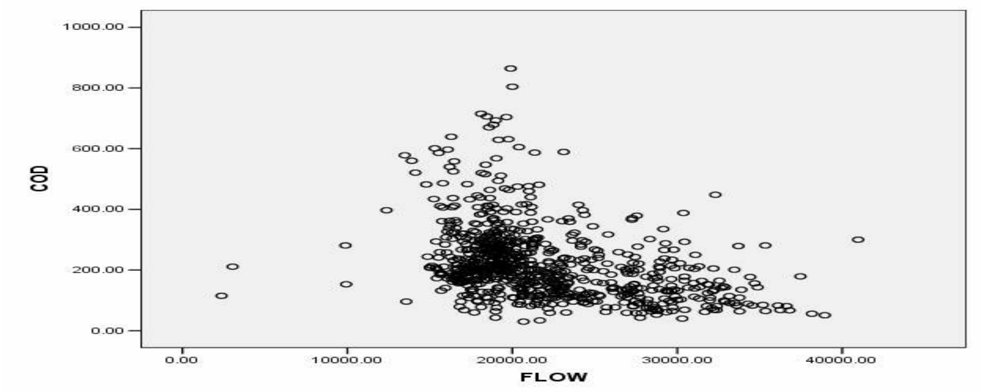


Figure 3.135 Scatter graphic of Guneybati influent COD-FLOW data

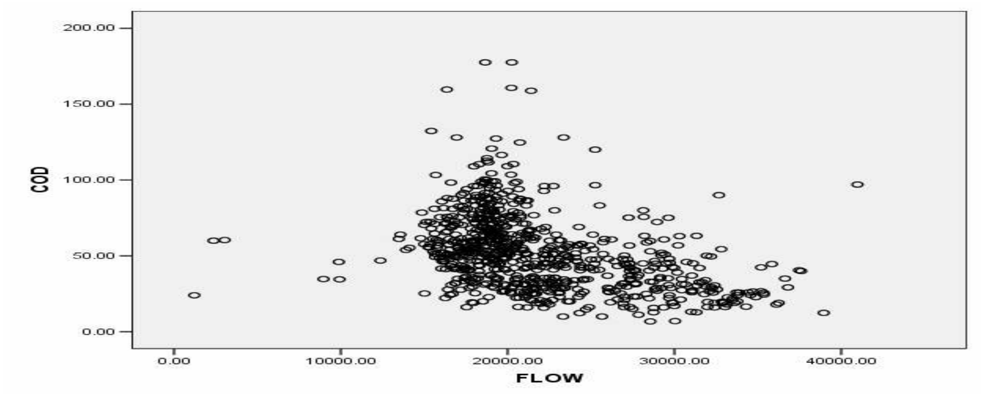


Figure 3.136 Scatter graphic of Guneybati effluent COD-FLOW data

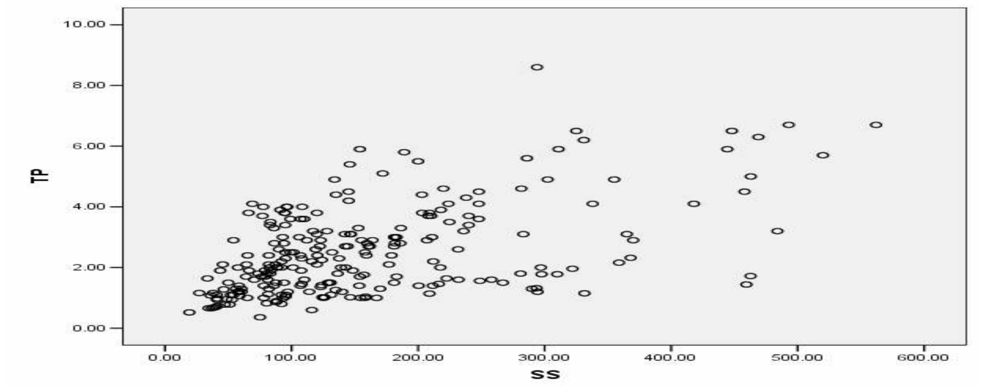


Figure 3.137 Scatter graphic of Guneybati influent TP-SS data

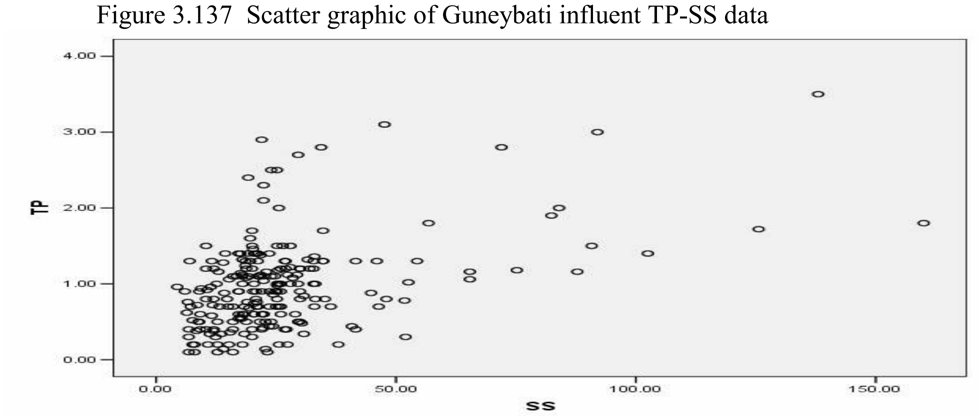


Figure 3.138 Scatter graphic of Guneybati effluent TP-SS data

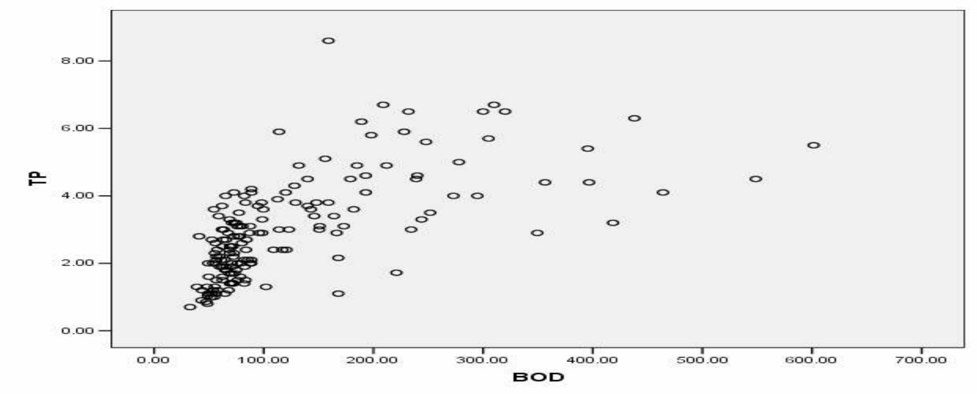


Figure 3.139 Scatter graphic of Guneybati influent TP-BOD data

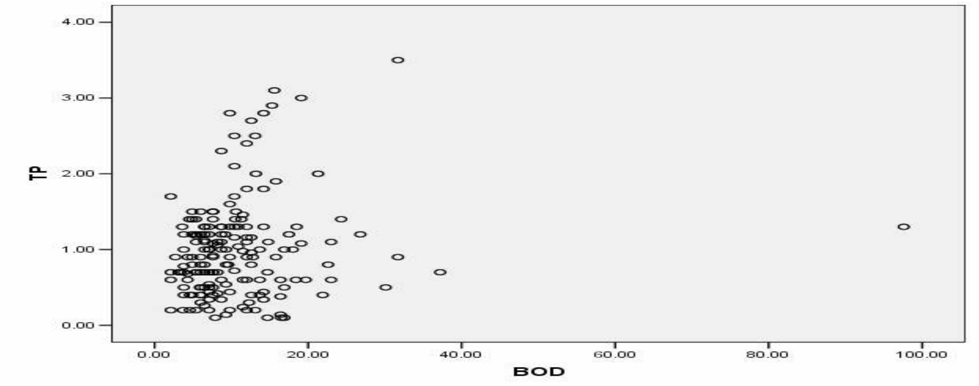


Figure 3.140 Scatter graphic of Guneybati effluent TP-BOD data

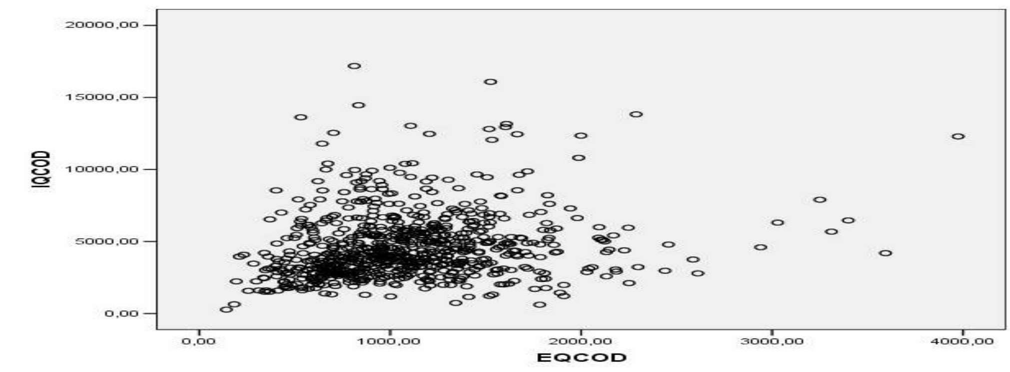


Figure 3.141 Scatter graphic of Guneybati IQCOD-EQCOD data

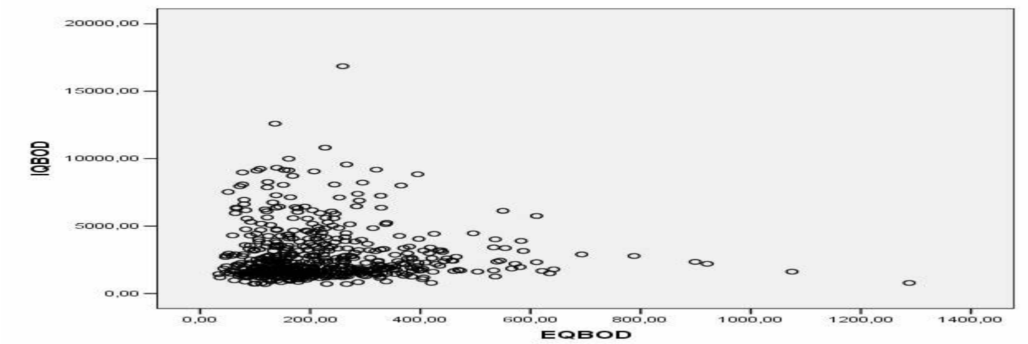
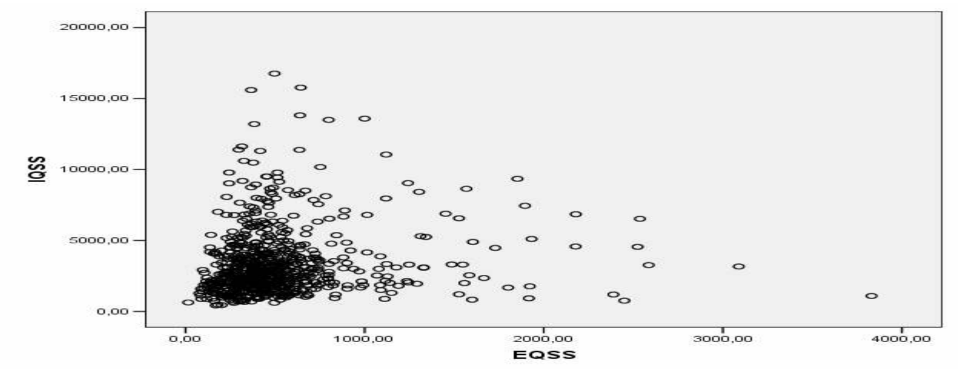
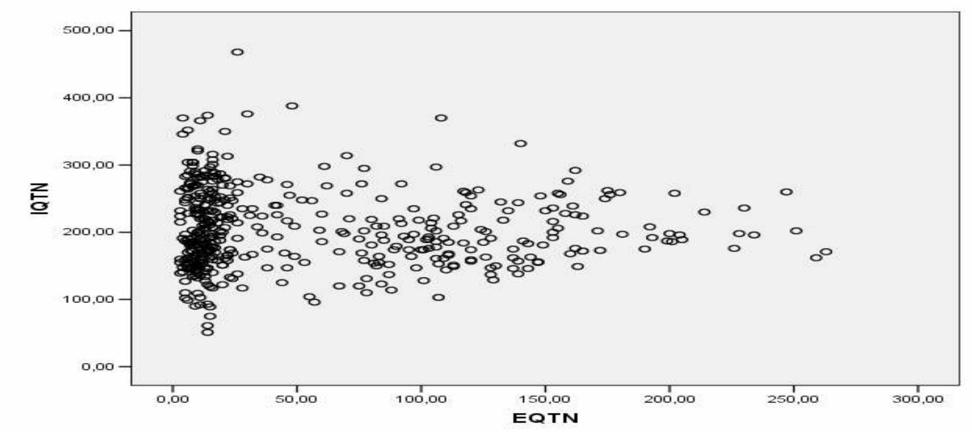


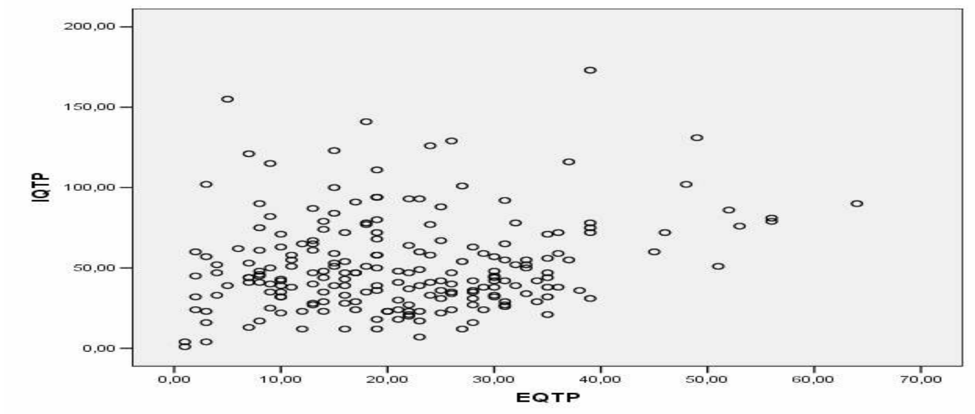
Figure 3.142 Scatter graphic of Guneybati IQBOD-EQBOD data



3.143 Scatter graphic of Guneybati IQSS-EQSS data



3.144 Scatter graphic of Guneybati IQTN-EQTN data



3.145 Scatter graphic of Guneybati IQTP-EQTP data

3.13 Regression of influent and effluent data of GWWTP

Ho= There is a relation between variables

H1= There is no any relation between variables.

With this hypothesis, the relation is analysed between COD and other variable of GWWTP. The regular and evident fact is that there is a relation between COD and other variables.Because of this Ho hypothesis is choosed "there is a relation between variables'

According to Table 3.28, correlation coefficient is 0.919, r square is 0.845, which shows that the independent values are describing 92 % of the variation for the dependent variable COD. There is a very strong relation between dependent variable COD and other variables.

At Table 3.29 Anova test showed that significant 0.00. Which means the model is significant. At Table 3.30 TP's p.>0.05, TN's p>0.05, BOD's p>0.05 and it's model is not significant so there is a relation between COD-TP,COD-TN, COD-BOD. But SS and Flow's p<0.05 which means Ho hypothesis is valid so there is no any relation between COD-SS and COD-Flow.

Table 3.28 Model summary of GWWTP influent data

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,919[a]	,845	,840	52,07711

a. Predictors: (Constant), FLOW, SS, BOD, TN, TP

Table 3.29 ANOVA of GWWTP influent data

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2131876	5	426375,240	157,217	,000[a]
	Residual	390531,6	144	2712,025		
	Total	2522408	149			

a. Predictors: (Constant), FLOW, SS, BOD, TN, TP

b. Dependent Variable: COD

Table 3.30 Coefficients for GWWTP's influent data

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	96,371	41,095		2,345	,020
	BOD	,141	,066	,096	2,120	,036
	SS	,853	,064	,673	13,394	,000
	TN	5,091	2,535	,118	2,008	,046
	TP	12,170	6,608	,129	1,842	,068
	FLOW	-,005	,001	-,158	-3,659	,000

a. Dependent Variable: COD

According to Table 3.31, correlation coefficient is 0.720, r square is 0.518, which shows that the independent values are describing 72 % of the variation for the dependent variable COD. There is a very strong relation between dependent variable COD and other variable.

At Table 3.32 Anova test showed that significant 0.00. Which means the model is significant. At Table 3.33 just SS , FLOW's p<.05 and it's model is significant but there is no any relation between SS-COD and COD-Flow. But for BOD, TN and TP , there is a relation with COD

Table 3.31 Model summary of GWWTP effluent data

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,720[a]	,518	,499	14,33173

a. Predictors: (Constant), FLOW, SS, TN, BOD, TP

Table 3.32 ANOVA of GWWTP's effluent data

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	26755,011	5	5351,002	26,052	,000[a]
	Residual	24853,212	121	205,398		
	Total	51608,223	126			

a. Predictors: (Constant), FLOW, SS, TN, BOD, TP

b. Dependent Variable: COD

Table 3.33 Coefficients of GWWTP's effluent data

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	61,057	8,569		7,125	,000
	BOD	,087	,228	,025	,382	,703
	SS	,649	,101	,432	6,398	,000
	TN	,906	,472	,130	1,922	,057
	TP	5,940	2,686	,152	2,211	,029
	FLOW	-,002	,000	-,399	-5,928	,000

a. Dependent Variable: COD

3.14 Boxplot of GWWTP values

Boxplot graphics allow us to make selections that determine the type of chart we obtain. The daily data with date of wwtp are used whole data analysis. To find extreme data which has abnormal distribution with boxplot graphics was possible for this reason boxplot graphics are prepeared for each variable

Table 3.34 Extreme values of GWWTP's influent value

COD	BOD	SS	TN	TP	QCOD	QTN	QTP	QBOD
7/03/2003	3/11/2004	23/7/2004	8/6/2005	23/7/2004	11/5/2005	20/4/2004	11/5/2005	3/11/2004
20/8/2004	09/7/2004	11/5/2005			9/7/ 2004		19/4/2003	20/10/2004
24/8/2005	24/11/200	30/7/2004			20/8/2004			27/10/2004
10/8/2005	15/12/2004	31/10/2003			15/1/2003			15/12/2004
	1/12/2004	6/8/2004			25/5/2004			3/8/2004
	3/8/2004	16/12/2003						23/7/2004
	30/7/2004							30/7/2004
	24/8/2005							

Table 3.35 Extreme values of GWWTP's influent value

BOD	SS	TP	QCOD	QBOD
29/6/2005	25/12/200 2	15/6/2004	23/1/2004	19/4/2003
8/6/2005	28/5/2004	13/7/2004		29/6/2005
15/6/2005	20/1/2003	11/6/2004		21/1/2003
3/8/2005	6/8/2004			9/4/2003
27/7/2005	24/9/2004			7/4/2003

These data which are at Table 3.34 and Table 3.35 are prepeared according to boxplot graphics. These data are extreme values because of this they should be removed or the data shoul be transformed.

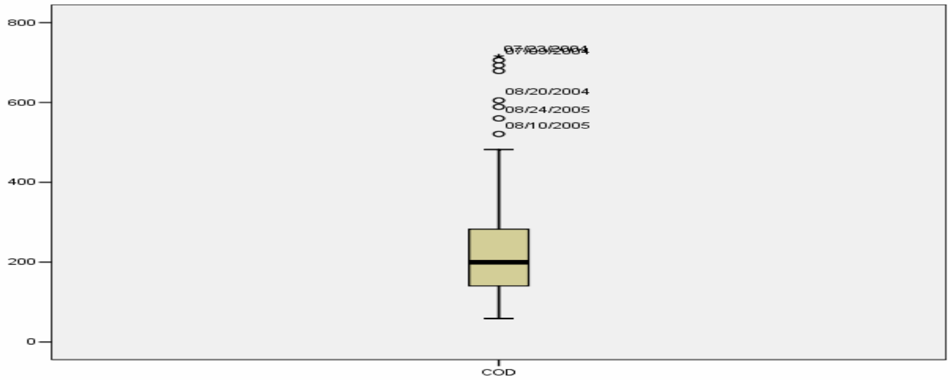


Figure 3.146 Boxplot graphic of GWWTP' s influent COD data

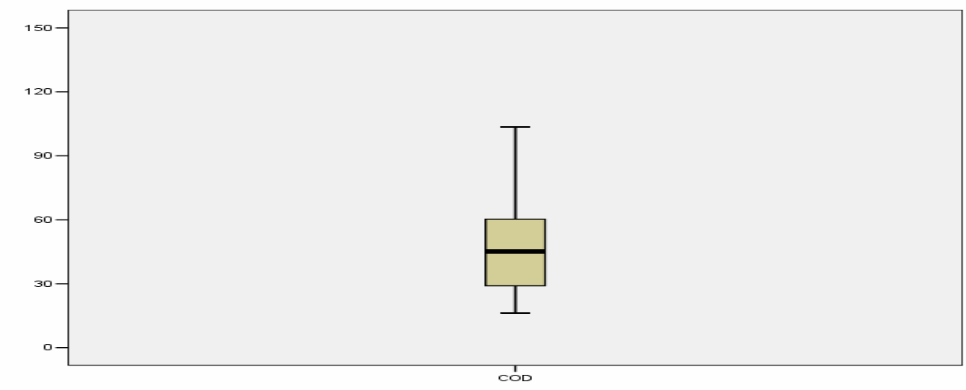


Figure 3.147 Boxplot graphic of GWWTP' s effluent COD data

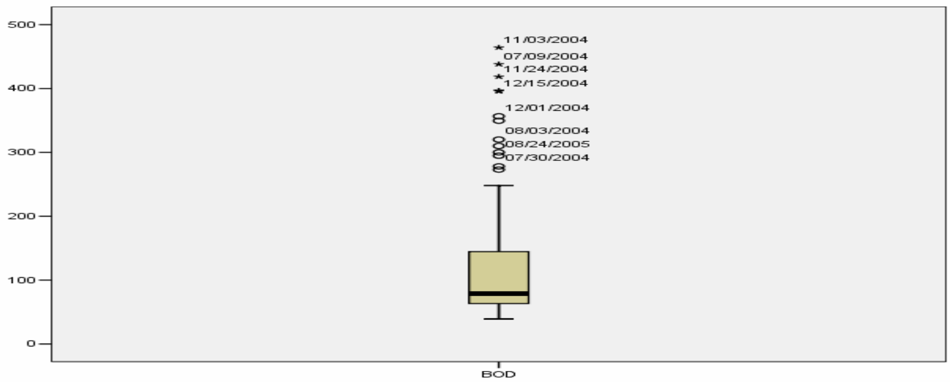


Figure 3.148 Boxplot graphic of GWWTP' s influent BOD data

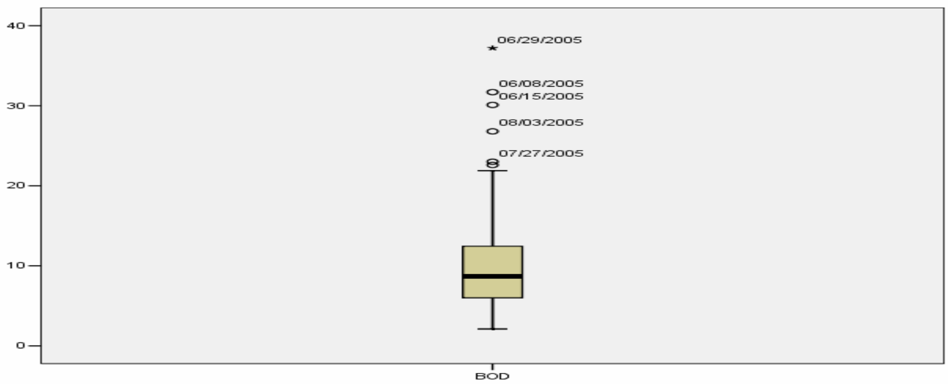


Figure 3.149 Boxplot graphic of GWWTP' s effluent BOD data

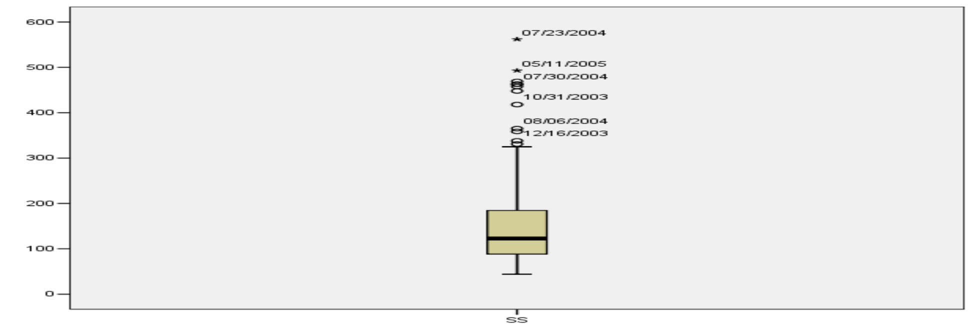


Figure 3.150 Boxplot graphic of GWWTP’ s influent SS data

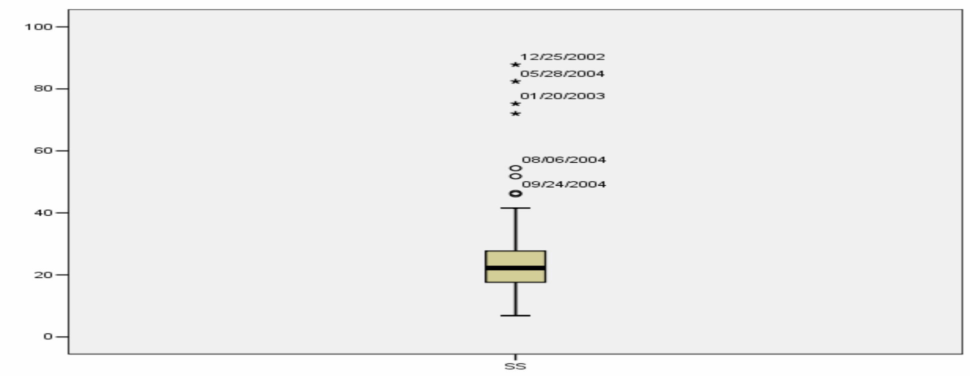


Figure 3.151 Boxplot graphic of GWWTP’ s effluent SS data

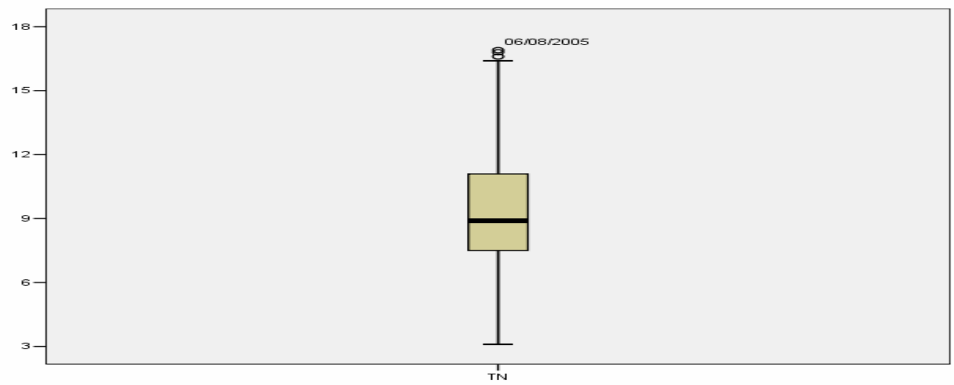


Figure 3.152 Boxplot graphic of GWWTP’ s influent TN data

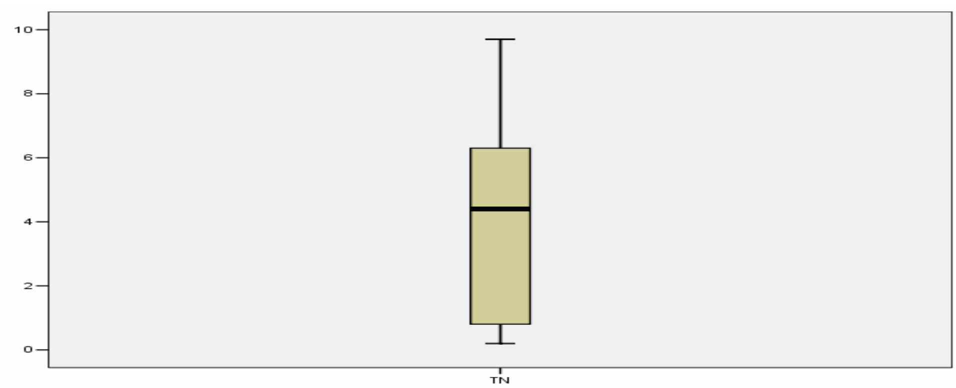


Figure 3.153 Boxplot graphic of GWWTP’ s effluent TN data

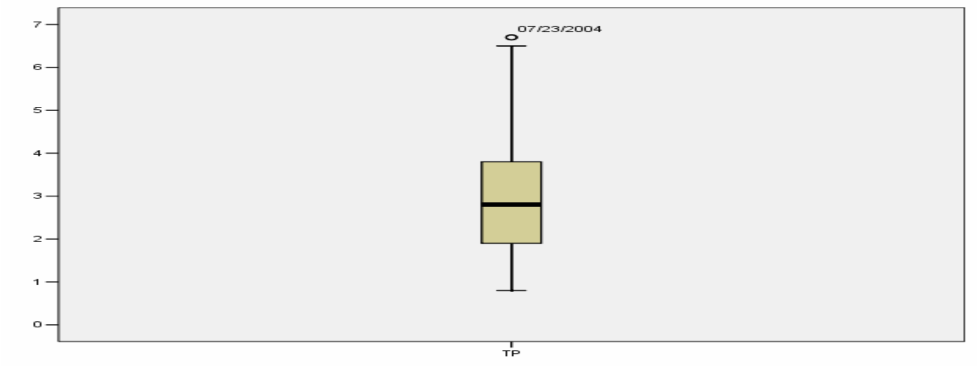


Figure 3.154 Boxplot graphic of GWWTP' s influent TP data

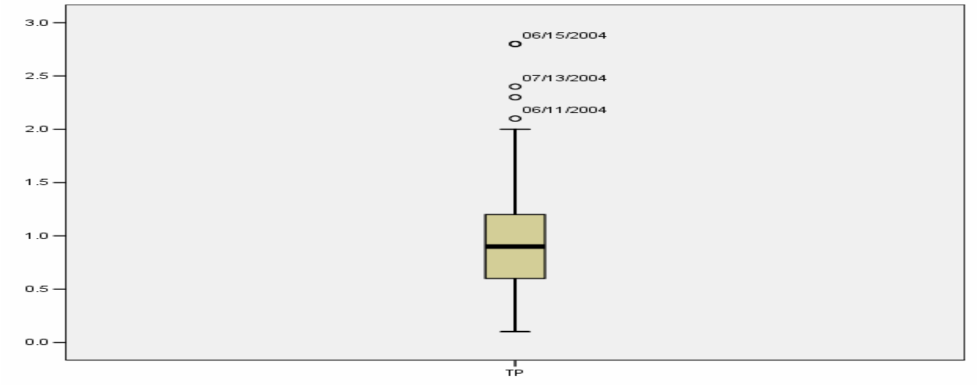


Figure 3.155 Boxplot graphic of GWWTP' s effluent TP data

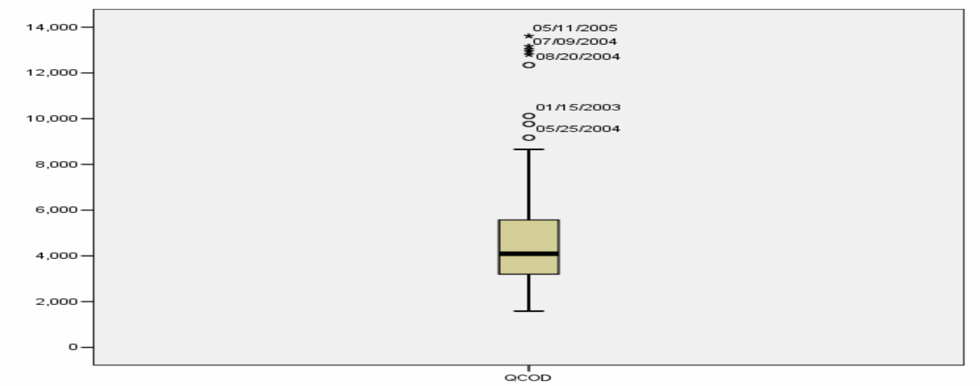


Figure 3.156 Boxplot graphic of GWWTP' s influent QCOD data

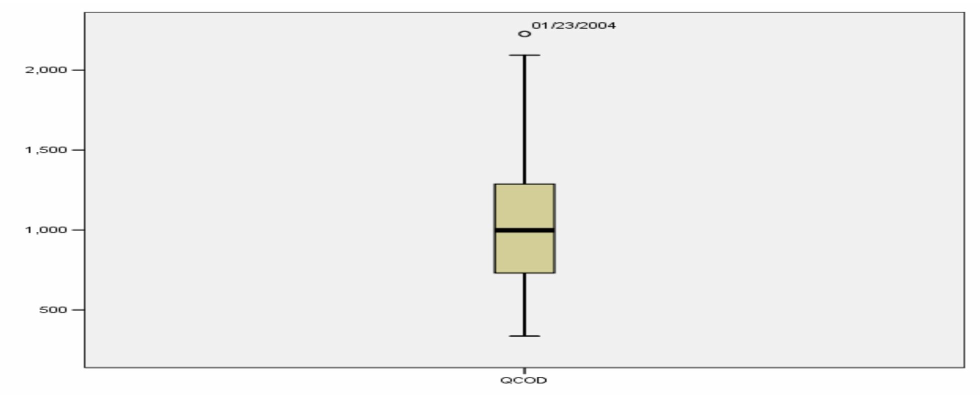


Figure 3.157 Boxplot graphic of GWWTP' s effluent QCOD data

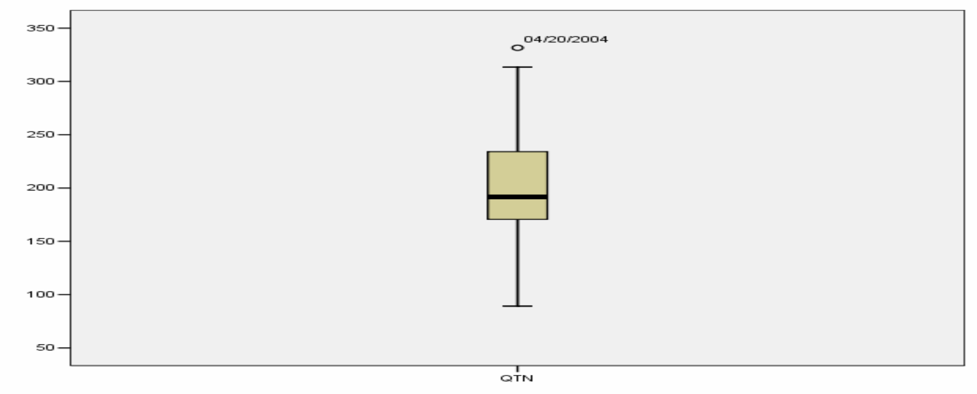


Figure 3.158 Boxplot graphic of GWWTP' s influent QTN data

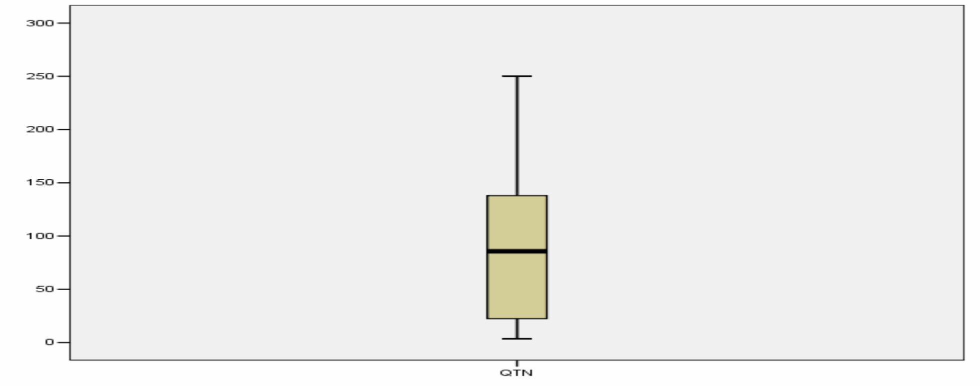


Figure 3.159 Boxplot graphic of GWWTP' s effluent QTN data

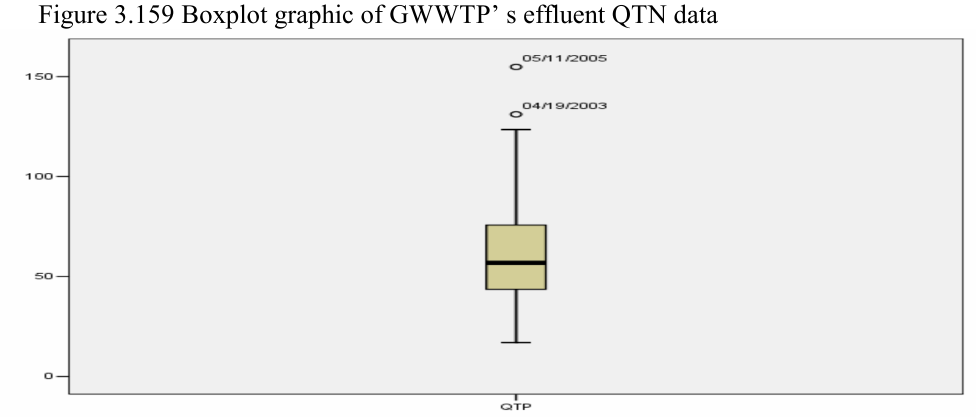


Figure 3.160 Boxplot graphic of GWWTP' s influent QTP data

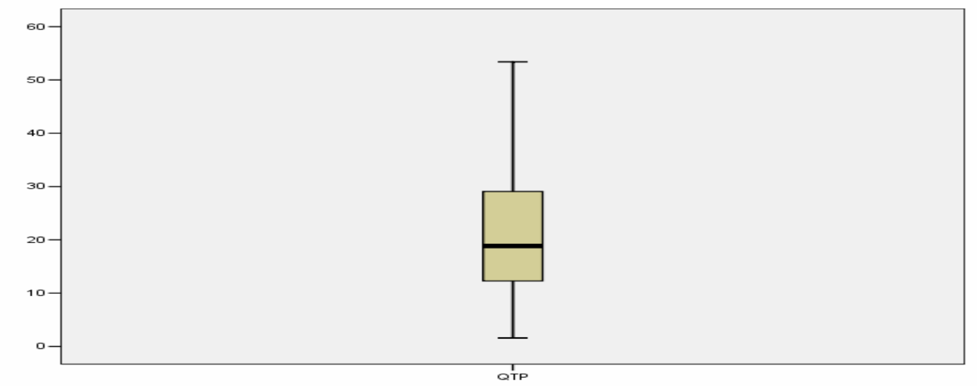


Figure 3.161 Boxplot graphic of GWWTP' s effluent QTP data

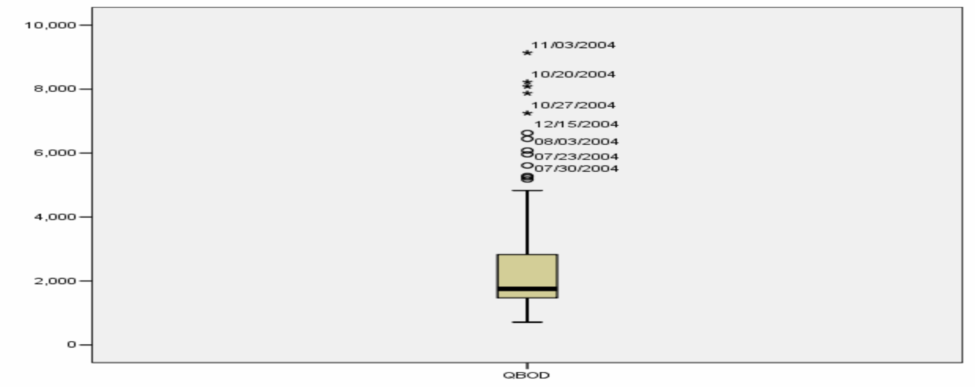


Figure 3.162 Boxplot graphic of GWWTP' s influent QBOD data

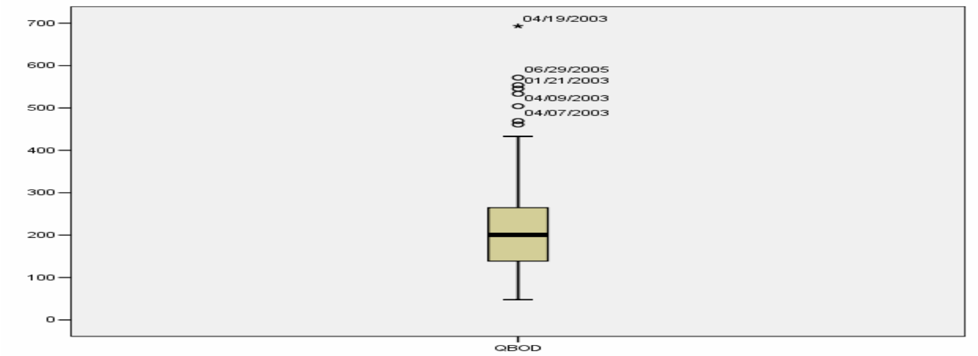


Figure 3.163 Boxplot graphic of GWWTP' s effluent QBOD data

3.15 Data frequency analysis and descriptive statistics of FWWTP's data

Total number of Foca WWTP data is 627. Considering the Table 3.36, we can say that BOD, FLOW, QCOD, QTN,QTP and QBOD's skewness is to right on histogram graphics, because of mean>median>mode condition. COD, SS, TP, TN's skewness are to left on histogram graphics. The abnormal distribution is observed expressly COD, BOD and SS data because mode values are considerably far from mean and median values. The other descriptive statistics; minimum value, maximum value, skewness, kurtosis coeffient are respectively 150mg/l, 1570 mg/l 0.544 and -1.246 for COD. 90 % values are lower than 1318 mg/l for COD. 65mg/l, 510 mg/l, 0.535, -1.23 for BOD, 118mg/l ,1620 mg/l, 0.204,.-1.43 for SS. 2.36 mg/l, 18.4 mg/l,-0.555, -0.486 for TP. 14.5 mg/l, 86 mg/l, -0.169, -0.557, for TN . 378.67 kg/day, 4885.66 kg/day, 0.71, 0.005 for QCOD. 143.88 kg/day, 2275.09 kg/day, 1.088, 1.207 for QBOD. 41.44 kg/day, 298.93 kg/day, 1.162, 1.435 for QTN. 3.24 kg/day, 108.93 kg/day, 1.208, 3.559 for QTP.

Considering the Table 3.37, we can say that COD, BOD, SS, TP, QCOD, QBOD QTP's skewness is to right on histogram graphics, because of mean>median>mode condition. TN, QTN's skewness are to left on histogram graphics. But mean, median and mode values are close and we can say that there is a normal distribution between FWWTP's data according to Table 3.37

Table 3.36 Mean, median and mode values of FWWTP's influent data

	COD mg/l	BOD mg/l	SS mg/l	TP mg/l	TN mg/l	FLOW m³/day	QCOD kg/day	QBOD kg/day	QTN kg/day	QTP kg/day
Mean	684.6	234.0	762.3	10.96	48.44	2710.6	1700.4	592.89	120.9	28.95
Median	540	198	640	11.8	47.3	2212	1489.4	472.84	112.4	27.32
Mode	1340	80	1420	12.4	62.4	1900	378.67	280	115.9	3.24

Table 3.37: Mean, median and mode values of FWWTP's effluent data

	COD mg/l	BOD mg/l	SS mg/l	TP mg/l	TN mg/l	FLOW m³/day	QCOD kg/day	QBOD kg/day	QTN kg/day	QTP kg/day
Mean	27.1	5.9	9.2	2.0	8.6	2706.7	69.2	14.7	23.5	6.1
Median	23.0	5.0	9.0	1.5	9.5	2211.0	60.3	13.5	20.6	3.5
Mode	24.0	4.0	9.0	1.5	9.5	1900.0	21.3	10.5	32.2	4.1

Table 3.38 Influent data frequency analysis and descriptive statistics of FWWTP

Statistics

		COD mg/l	BOD mg/l	SS mg/l	TP mg/l	TN mg/l	FLOW m3/day	QCOD kg/day	QBOD kg/day	QTN kg/day	QTP kg/day
N	Valid	371	213	365	371	369	431	371	213	369	371
	Missing	256	414	262	256	258	196	256	414	258	256
Mean		684.69	234.05	762.32	10.96	48.44	2710.68	1700.49	592.90	120.95	28.95
Std. Error of Mean		21.28	10.09	25.46	.19	.78	64.28	50.65	26.43	2.20	.74
Median		540.00	198.00	640.00	11.80	47.30	2212.00	1489.48	472.85	112.47	27.33
Mode		1340.00	80.00	1420.00	12.40	62.40	1900.00[a]	378.67[a]	280.00	115.94	3.24[a]
Std. Deviation		409.87	147.26	486.45	3.61	14.96	1334.40	975.67	385.77	42.17	14.23
Variance		167995.50	21684.52	236630.02	13.02	223.83	1780628	951933.31	148815.88	1778.41	202.50
Skewness		.54	.54	.20	-.56	-.17	1.91	.71	1.09	1.16	1.21
Std. Error of Skewness		.13	.17	.13	.13	.13	.12	.13	.17	.13	.13
Kurtosis		-1.25	-1.24	-1.44	-.49	-.60	3.11	.00	1.21	1.43	3.56
Std. Error of Kurtosis		.25	.33	.25	.25	.25	.23	.25	.33	.25	.25
Range		1420.00	445.00	1501.51	16.24	71.50	6672.00	4506.99	2131.20	257.49	105.68
Minimum		150.00	65.00	118.49	2.36	14.50	1150.00	378.67	143.88	41.44	3.24
Maximum		1570.00	510.00	1620.00	18.60	86.00	7822.00	4885.66	2275.09	298.93	108.93
Sum		254019.00	49853.00	278245.91	4066.44	17875.24	1168305	630880.77	126287.19	44630.99	10740.67
Percentiles	10	251.00	78.80	151.37	5.36	32.40	1701.60	513.50	185.69	77.82	11.63
	20	298.00	85.00	180.61	7.15	35.67	1812.80	701.84	257.68	86.43	17.52
	25	326.00	91.00	320.00	8.36	36.75	1862.00	934.69	278.36	90.79	20.42
	30	350.00	110.00	420.00	9.64	38.60	1903.00	1083.76	296.27	94.12	22.13
	40	503.20	155.80	534.00	11.20	42.50	2015.40	1253.43	386.21	101.15	25.21
	50	540.00	198.00	640.00	11.80	47.30	2212.00	1489.48	472.85	112.47	27.33
	60	620.00	235.40	896.00	12.40	53.91	2470.00	1919.40	641.20	120.31	30.31
	70	960.00	316.00	1180.00	13.40	58.60	2811.60	2225.16	760.46	131.00	32.93
	75	1180.00	410.00	1280.00	13.50	61.20	2932.00	2325.64	847.28	141.59	35.43
	80	1240.00	430.00	1360.00	13.86	63.50	3208.40	2465.65	917.31	150.64	38.44
	90	1318.00	460.00	1430.00	15.06	68.40	5068.80	3051.20	1154.93	182.00	47.14

a. Multiple modes exist. The smallest value is shown

Table 3.39 Effluent data frequency analysis and descriptive statistics of FWWTP

Statistics

		COD mg/l	BOD mg/l	SS mg/l	TP mg/l	TN mg/l	FLOW m³/day	QCOD kg/day	QBOD kg/day	QTN kg/day	QTP kg/day
N	Valid	370	213	368	355	371	430	371	214	372	356
	Missing	257	414	259	272	256	197	256	413	255	271
Mean		27.1342	5.9314	9.1973	2.0223	8.6382	2706.6770	69.1707	14.7097	23.4941	6.0852
Std. Error of Mean		.60795	.20329	.14333	.13138	.15431	64.30044	1.58701	.45982	.72904	.51631
Median		23.0000	5.0000	9.0000	1.5000	9.5000	2211.0000	60.2837	13.4879	20.5553	3.5451
Mode		24.00	4.00	9.00	1.50	9.50	1900.00[a]	21.30[a]	10.50[a]	32.20	4.07
Std. Deviation		11.69409	2.96691	2.74951	2.47543	2.97218	1333.362	30.56789	6.72655	14.06117	9.74174
Variance		136.752	8.803	7.560	6.128	8.834	1777855	934.396	45.246	197.717	94.901
Skewness		2.185	1.141	.508	4.070	-1.710	1.921	1.167	1.247	.916	3.947
Std. Error of Skewness		.127	.167	.127	.129	.127	.118	.127	.166	.126	.129
Kurtosis		3.804	1.565	1.125	15.397	2.074	3.161	.884	2.896	1.099	14.787
Std. Error of Kurtosis		.253	.332	.254	.258	.253	.235	.253	.331	.252	.258
Range		60.40	16.00	18.00	14.94	11.81	6672.00	159.45	44.16	72.09	58.62
Minimum		17.60	1.00	2.00	.46	.15	1150.00	21.30	4.83	.50	.70
Maximum		78.00	17.00	20.00	15.40	11.96	7822.00	180.75	48.99	72.59	59.33
Sum		10039.66	1263.38	3384.60	717.93	3204.76	1163871	25662.32	3147.87	8739.81	2166.32
Percentiles	10	19.8000	3.0000	6.0000	1.1000	3.2800	1700.8000	39.8078	7.2580	5.5738	2.0233
	20	20.4000	3.0000	7.0000	1.2500	7.8380	1812.4000	44.6861	8.8544	14.3502	2.5381
	25	21.0000	4.0000	8.0000	1.3000	8.5700	1861.7500	46.4793	9.5952	15.5685	2.6939
	30	21.1300	4.0000	8.0000	1.3500	8.7660	1903.0000	47.7254	10.9417	16.7680	2.8714
	40	22.1000	5.0000	8.7040	1.4000	9.2460	2014.2000	51.8446	12.0000	19.0554	3.2101
	50	23.0000	5.0000	9.0000	1.5000	9.5000	2211.0000	60.2837	13.4879	20.5553	3.5451
	60	24.0000	6.0000	10.0000	1.5460	9.7000	2468.6000	67.6463	15.1896	23.4283	3.8600
	70	24.9400	7.0000	10.0000	1.6220	10.2000	2797.0000	77.1437	17.1342	28.1640	4.3069
	75	25.4000	8.0000	11.0000	1.6700	10.5000	2932.0000	84.0000	18.7570	30.9358	4.7051
	80	26.4000	8.0000	11.0000	1.7000	10.8000	3205.0000	94.9620	20.3600	32.7184	5.2453
	90	48.0000	10.0000	12.0000	1.8100	11.3000	5083.9000	116.6365	23.2235	43.2820	8.2039

a. Multiple modes exist. The smallest value is shown

3.16 Histogram of FWWTP's data

According to the graphics, at the first sight the normal distribution is not observed. Figure 3.167 (BOD_5 effluent), Figure 3.169 (SS effluent), and Figure 3.177 ($QBOD_5$ effluent) seem to have a normal distribution, because the histogram graphics of them are symmetrical and the tails of graphics don't tend to right or left side on graphics.

If we inspect the graphics, in Figure 3.164 and 3.165, we see tendancy to right. On Figure 3.165 COD effluent values have low frequency after 60 mg/l. The tail of distrubiton tend to right. Which means that skewness coefficient should be bigger than 1. If we look at Table 3.36, we see skewness coefficient is 2.189 which confirmes our comment above. The values have low frequency over 15mg/l on Figure 3.167, over 80 mg/l on Figure 3.170, over 10mg/l on Figure 3.171, over 40mg/l on Figure 3.172, over 160 kg/day on Figure 3.175, over 3000kg/day on Figure 3.176, over 40kg/day on Figure 3.177, over 1000 kg/day on Figure 3.178, and they tend to right.

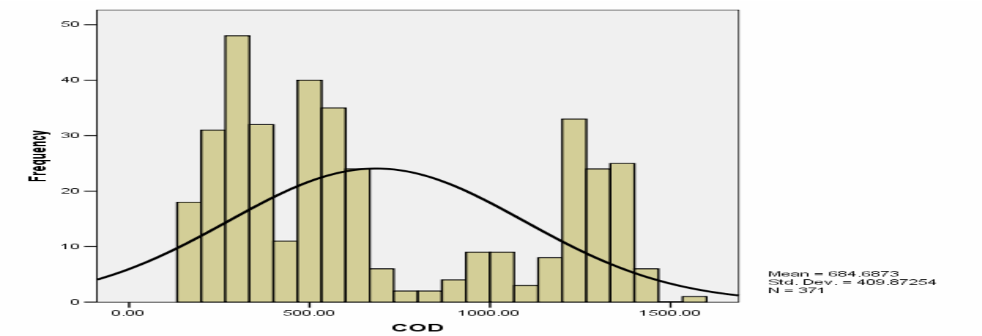


Figure 3.164 FWWTP frequency graphic of COD in influent data

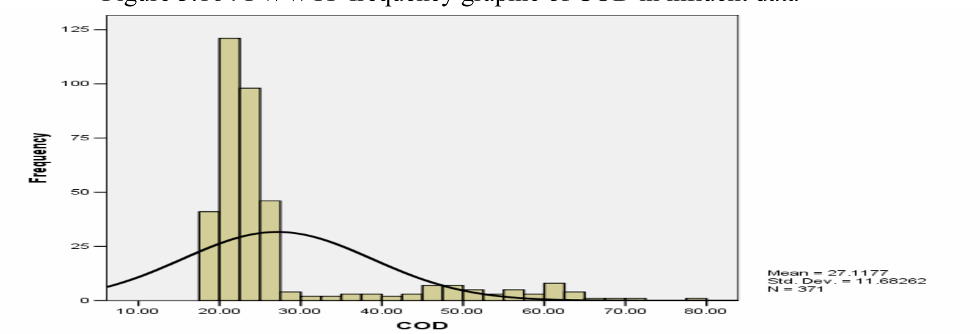


Figure 3.165 FWWTP frequency graphic of COD in effluent data

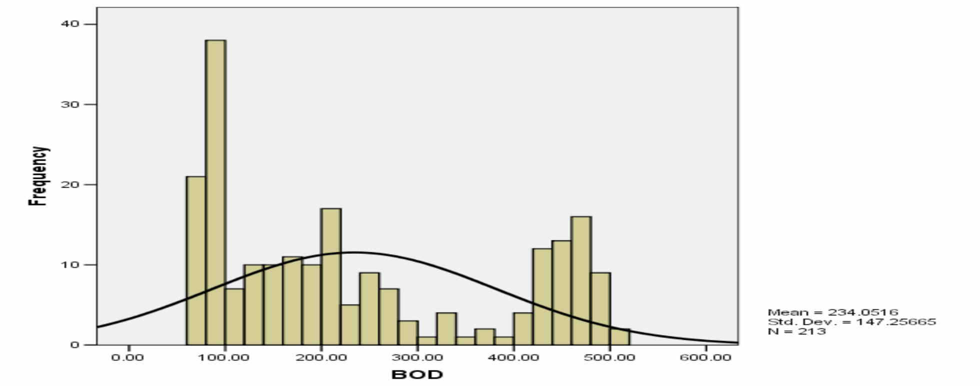


Figure 3.166 FWWTP frequency graphic of BOD in influent data

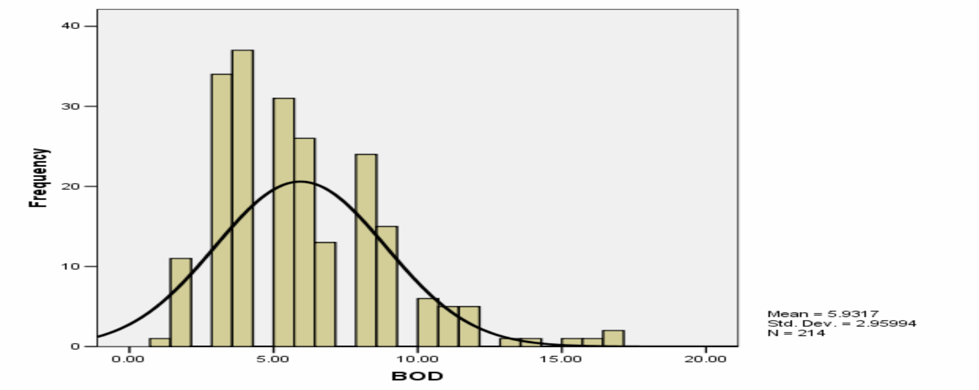


Figure 3.167 FWWTP frequency graphic of BOD in effluent data

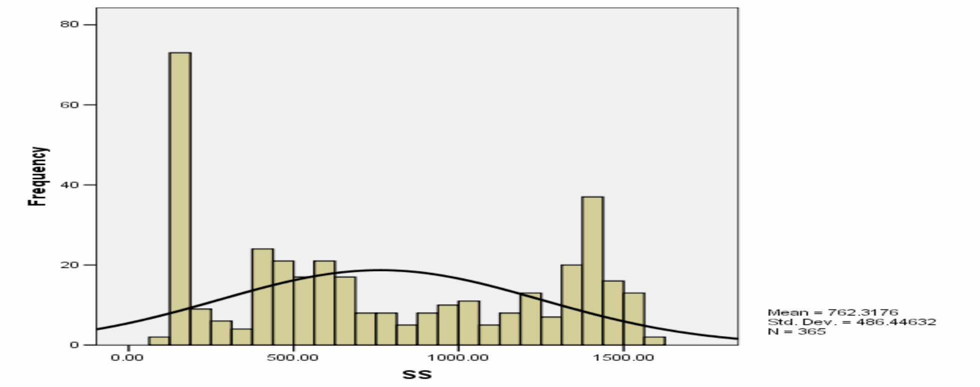


Figure 3.168 FWWTP frequency graphic of SS in influent data

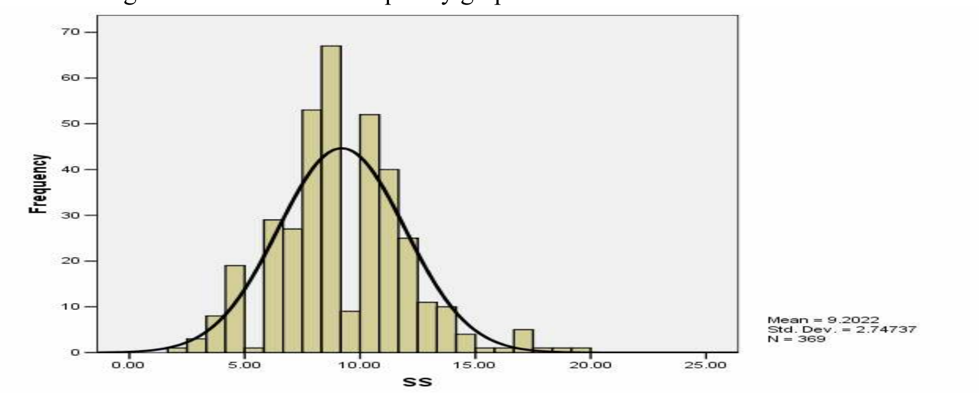


Figure 3.169 FWWTP frequency graphic of SS in effluent data

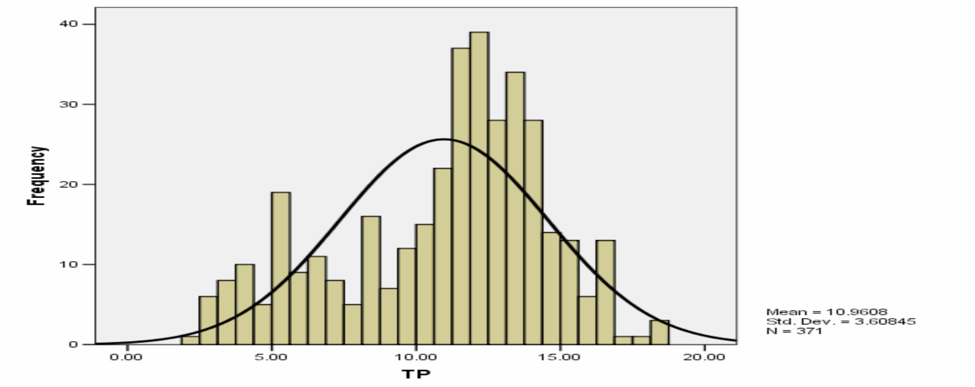


Figure 3.170 FWWTP frequency graphic of TP in influent data

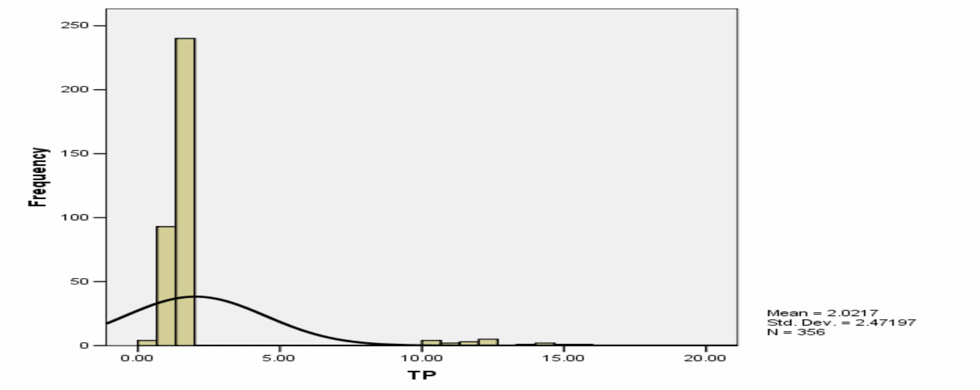


Figure 3.171 FWWTP frequency graphic of TP in effluent data

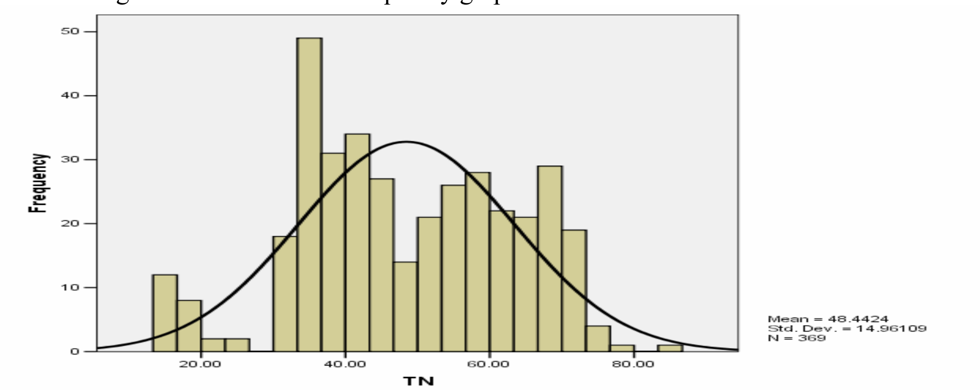


Figure 3.172 FWWTP frequency graphic of TN in influent data

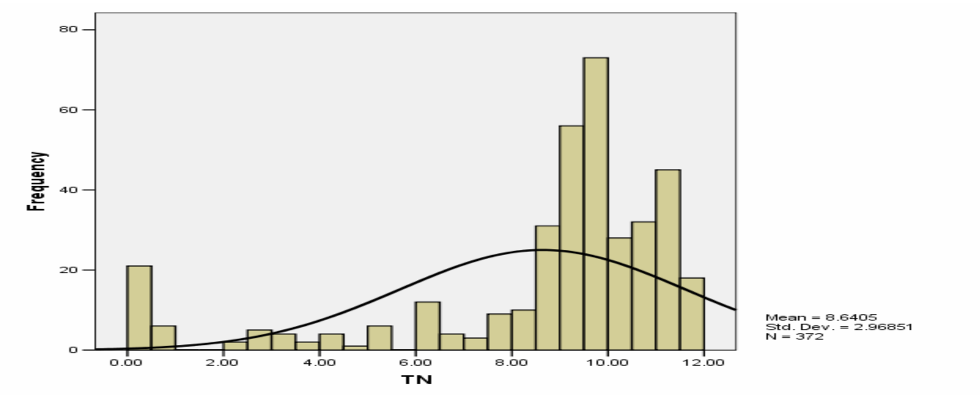


Figure 3.173 FWWTP frequency graphic of TN in effluent data

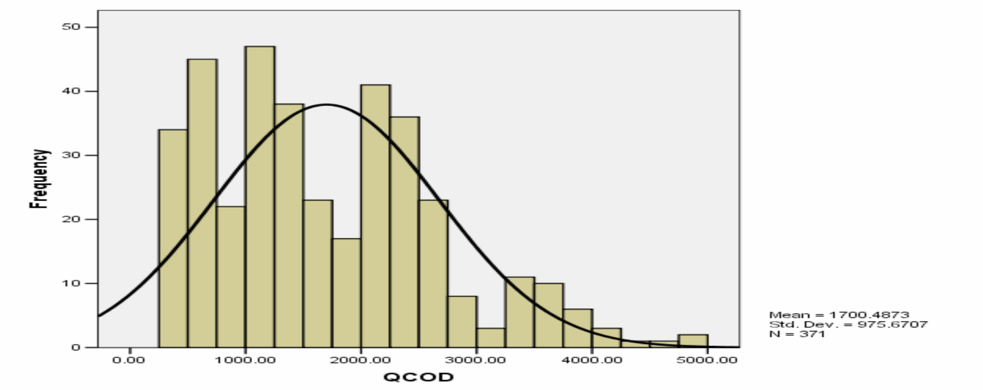


Figure 3.174 FWWTP frequency graphic of QCOD in influent data

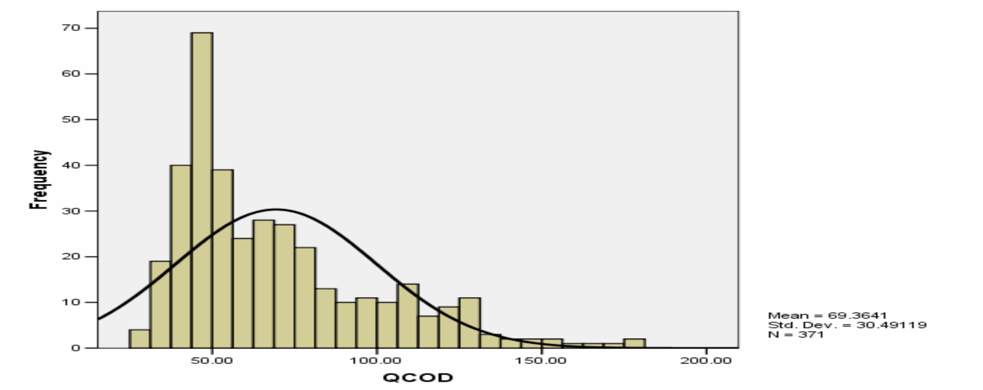


Figure 3.175 FWWTP frequency graphic of QCOD in effluent data

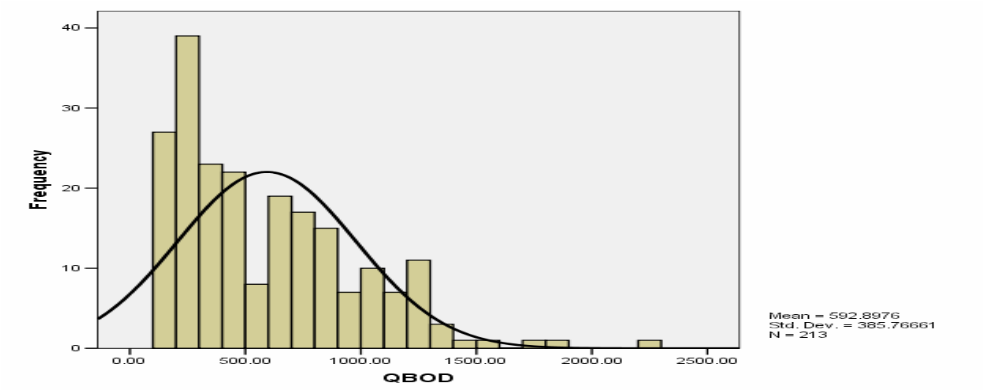


Figure 3.176 FWWTP frequency graphic of QBOD in influent data

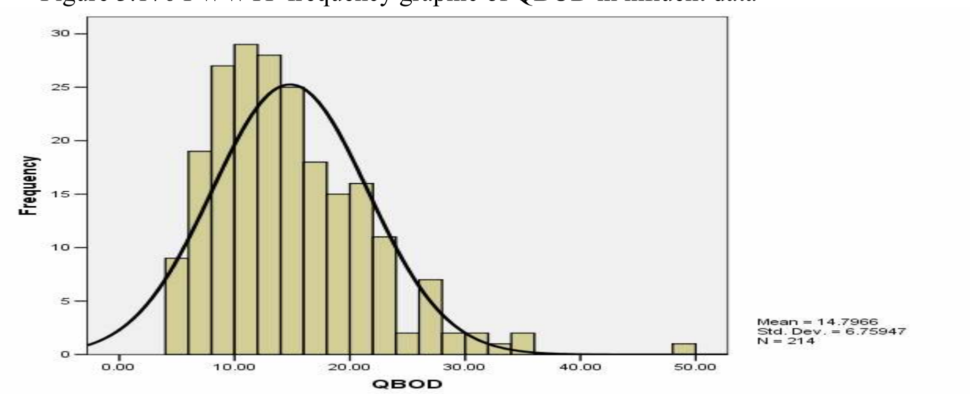


Figure 3.177 FWWTP frequency graphic of QBOD in effluent data

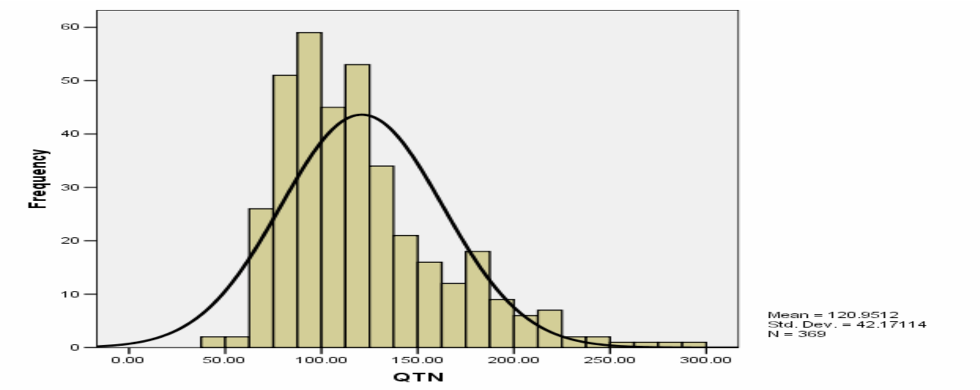


Figure 3.178 FWWTP frequency graphic of QTN in influent data

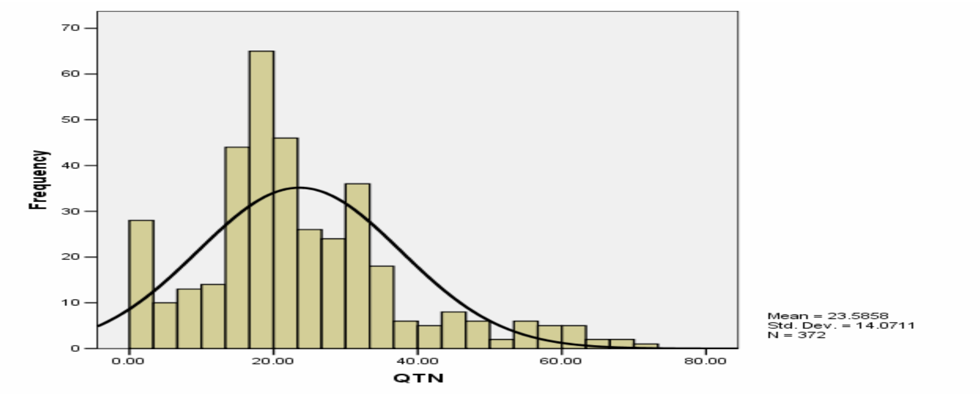


Figure 3.179 FWWTP frequency graphic of QTN in effluent data

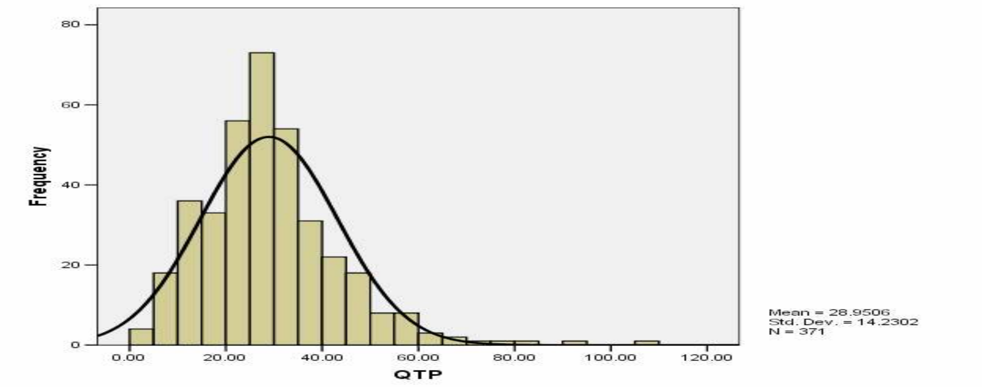


Figure 3.180 FWWTP frequency graphic of QTP in influent data

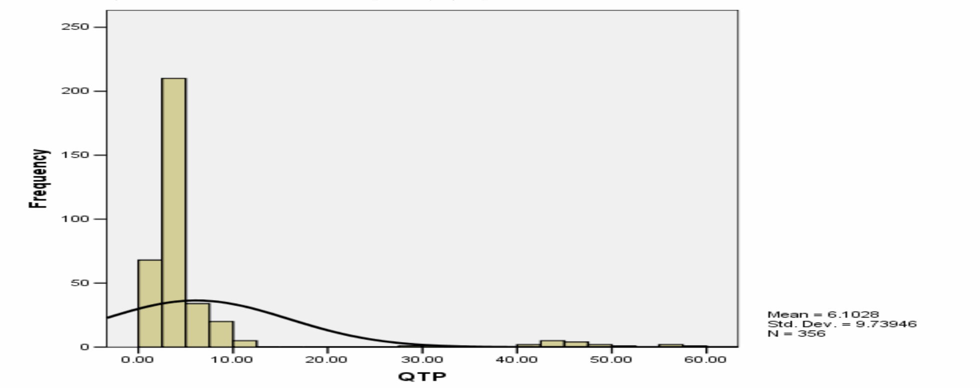


Figure 3.181 FWWTP frequency graphic of QTP in effluent data

3.17 Homogeneity analysis of data

According to the graphics, a homogenenous distrubution is not observed. The values are distributed according to the dimensions on the graphics. If we look at Figure 3.182, at Figure 3.184, at Figure 3.186, at Figure 3.190, at Figure 3.194 6. and 7. groups are close to each other but the other groups are far. These groups are composed homogen group. And the other groups create abnormal distribution during data analysis.For this reason homogeneity analysis are used and heterogeneous data are established

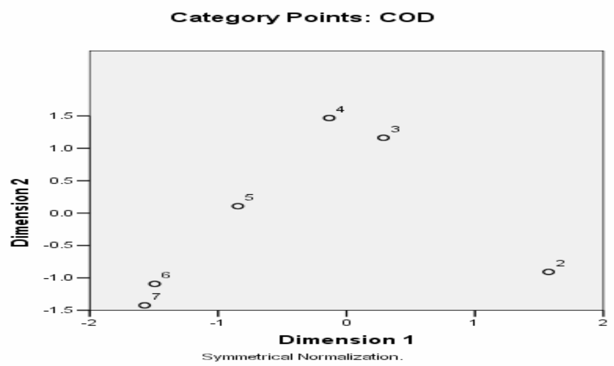


Figure 3.182 Symmetrical normalization of FWWTP's influent COD data

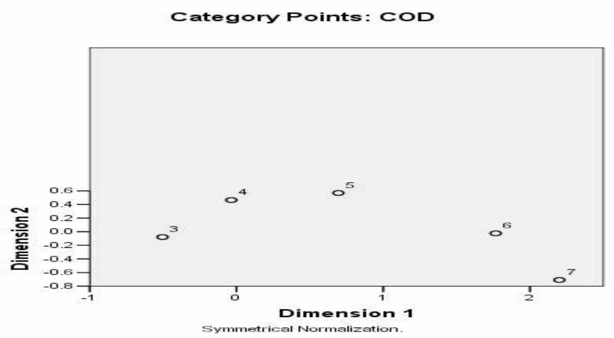


Figure 3.183 Symmetrical normalization of FWWTP's effluent COD data

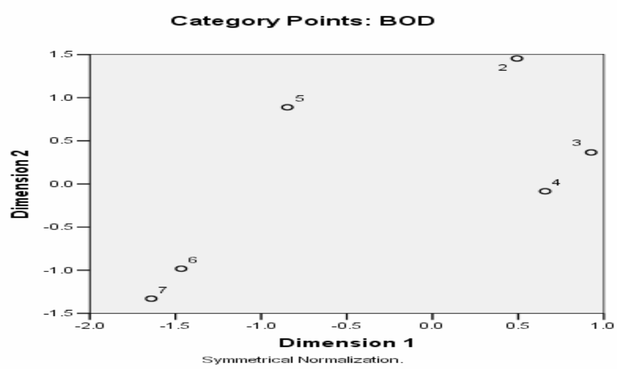


Figure 3.184 Symmetrical normalization of FWWTP's influent BOD data

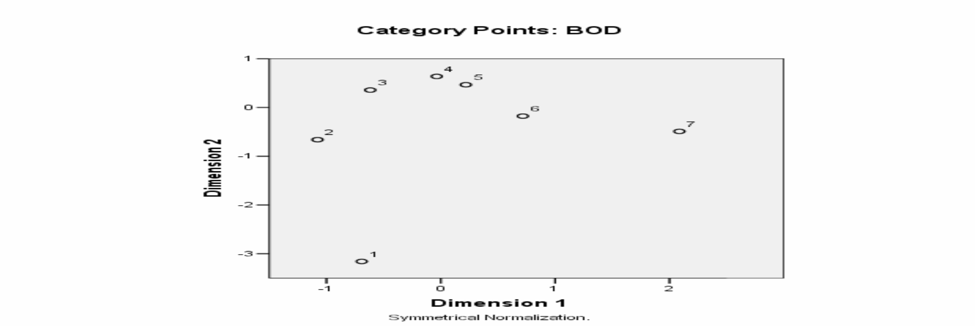


Figure 3.185 Symmetrical normalization of FWWTP's effluent BOD data

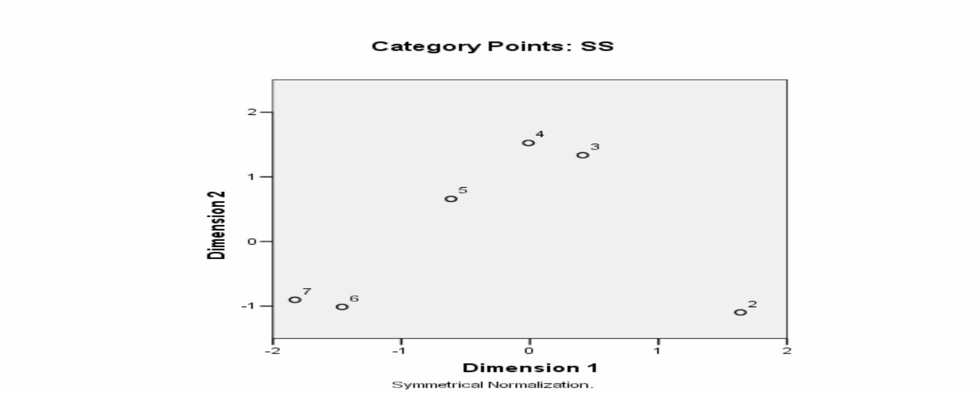


Figure 3.186 Symmetrical normalization of FWWTP's influent SS data

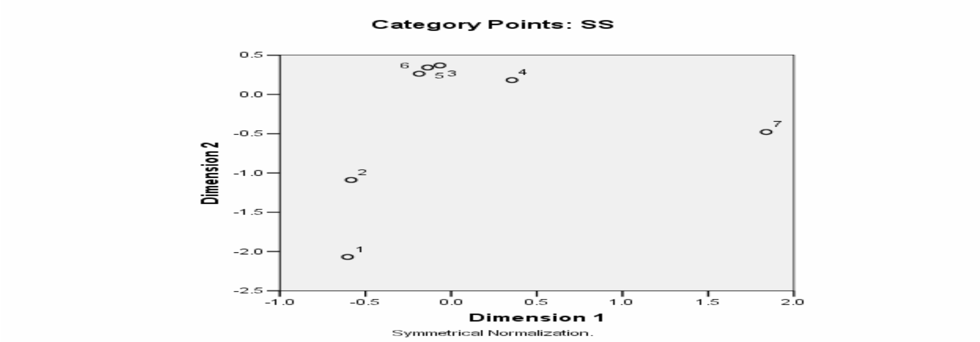


Figure 3.187 Symmetrical normalization of FWWTP's effluent SS data

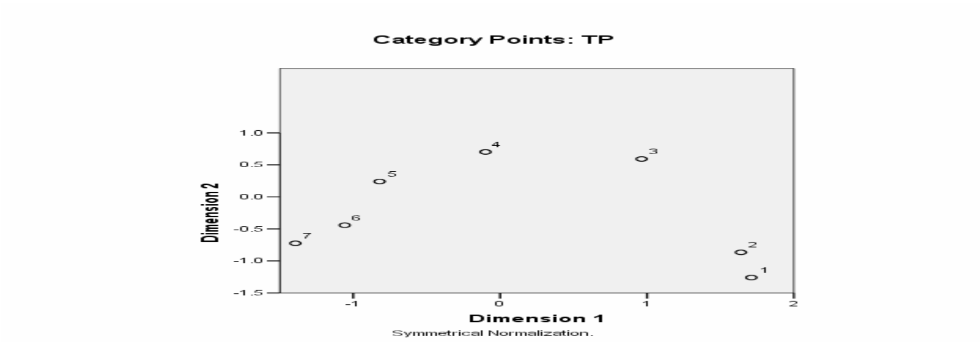


Figure 3.188 Symmetrical normalization of FWWTP's influent TP data

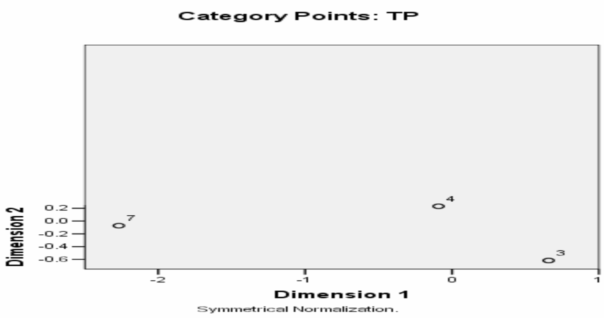


Figure 3.189 Symmetrical normalization of FWWTP's effluent TP data

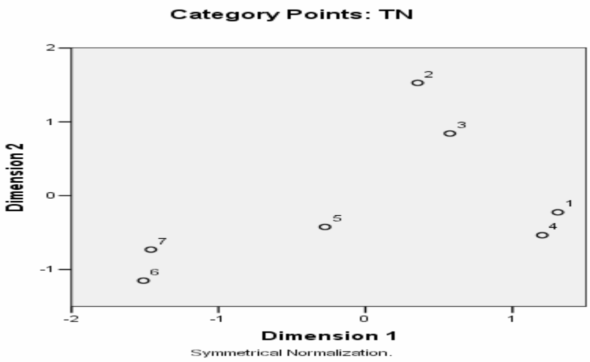


Figure 3.190 Symmetrical normalization of FWWTP's influent TN data

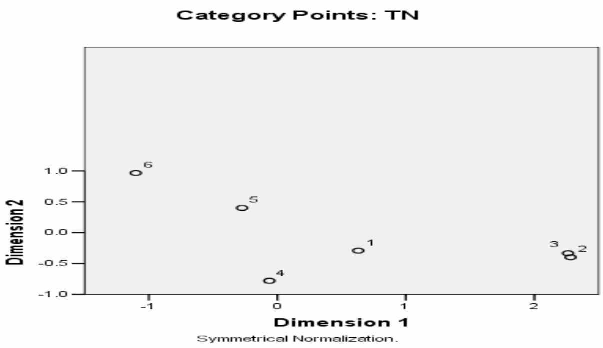


Figure 3.191 Symmetrical normalization of FWWTP's effluent TN data

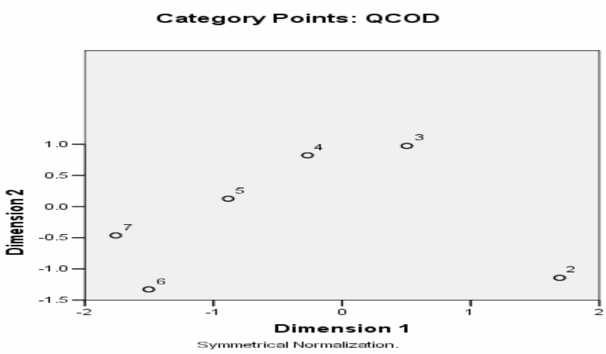


Figure 3.192 Symmetrical normalization of FWWTP's influent QCOD data

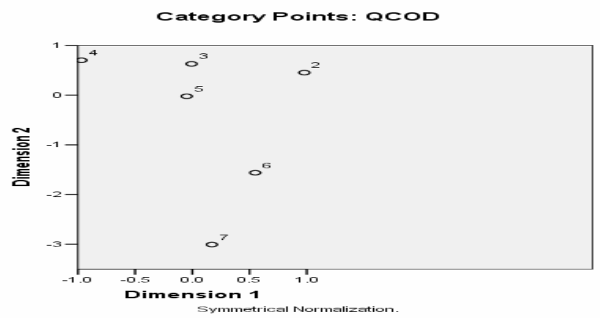


Figure 3.193 Symmetrical normalization of FWWTP's effluent QCOD data

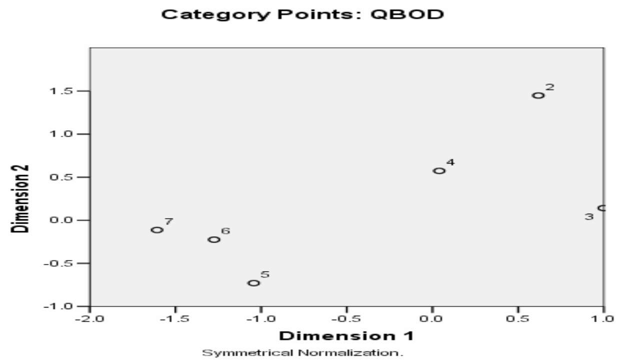


Figure 3.194 Symmetrical normalization of FWWTP's influent QBOD data

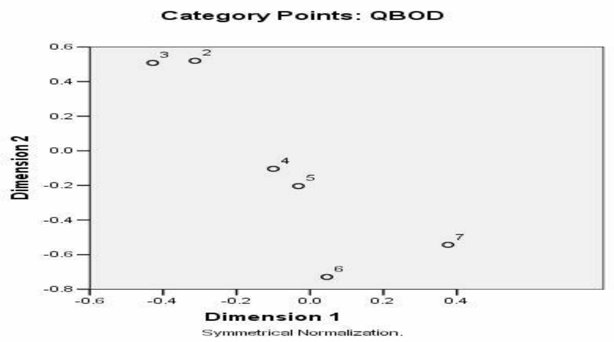


Figure 3.195 Symmetrical normalization of FWWTP's effluent QBOD data

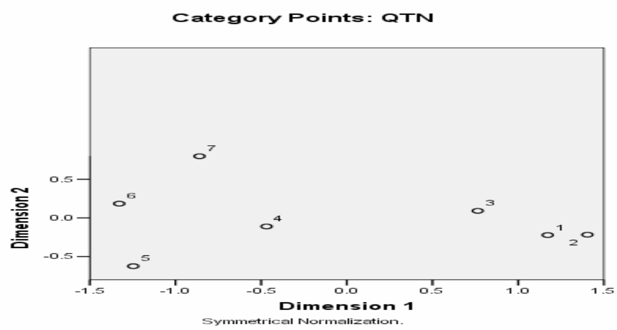


Figure 3.196 Symmetrical normalization of FWWTP's influent QTN data

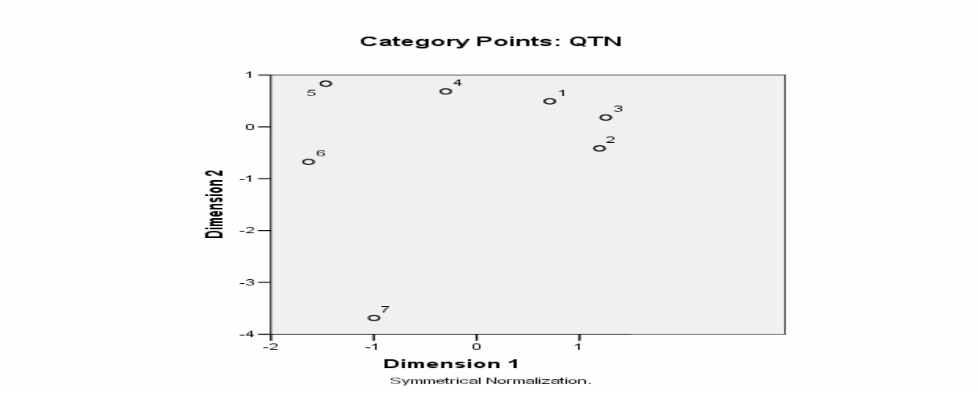


Figure 3.197 Symmetrical normalization of FWWTP's effluent QTN data

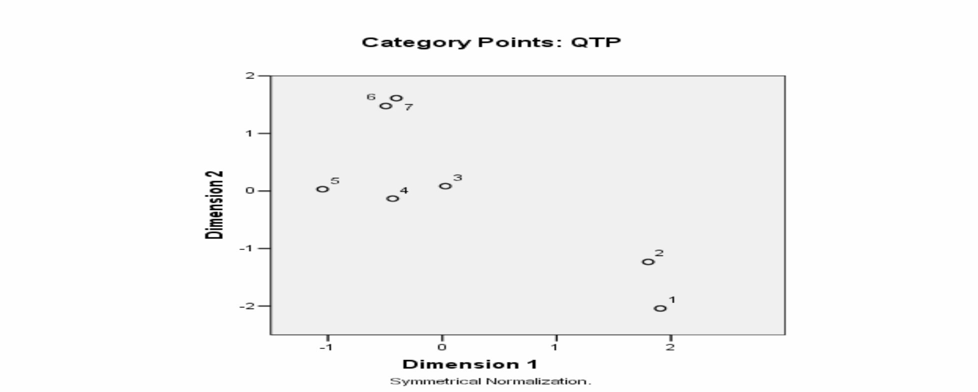


Figure 3.198 Symmetrical normalization of FWWTP's influent QTP data

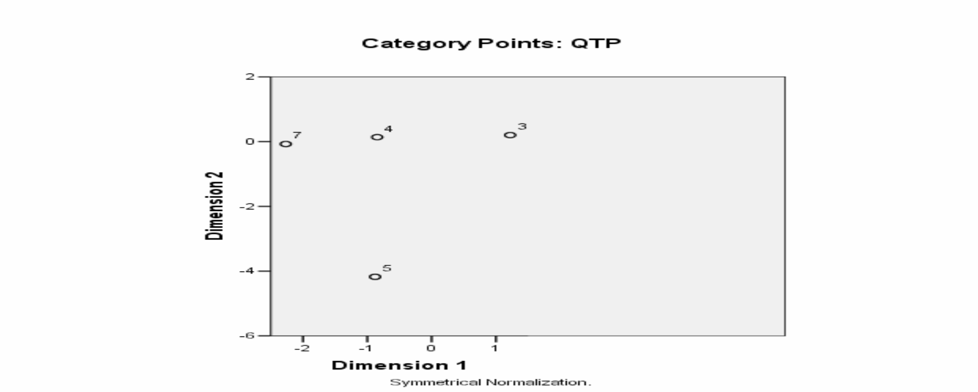


Figure 3.199 Symmetrical normalization of FWWTP's effluent QTP data

3.18 Correlation Analysis of FWWTP' s data

In this study, the spearman correlation analysis is used for 6 variables. Each variable are compared each other.

When Table 3.40 is inspected, correlation coefficient of COD-BOD association is found 0.818 which means COD-BOD_5 correlation is strong. Similar strong correlations are found between COD-SS (0.907), $p<0.05$, (0.824), $p<0.05$, COD-TP (0.708), $p<0.05$, COD-TN (0.779), $p<0.05$, SS-TP (0.732), $p<0.05$, SS-TN (0.701), $p<0.05$. Which means is correlation coefficient is significant statistically and there is a strong relation between COD-SS, COD-BOD_5, BOD_5-SS, COD-TP, COD-TN, SS-TP, SS-TN.

When Table 3.41 is inspected and, correlation coefficient of COD-BOD association is found 0.598, $p<0.05$ which means COD-BOD_5 correlation is strong. Similar strong correlations are found between COD-SS (0.337), $p<0.05$, BOD_5-SS (0.341). $p<0.05$. When the table 3.41 is inspected, there is a relation between COD-BOD_5, COD-SS, BOD_5-SS.

Table 3.40 Correlation Analysis table of FWWTP' s influent data

Correlations

		COD	BOD	SS	TP	TN	FLOW
COD	Spearman Correlation	1	,818 **	,907 **	,708 **	,779 **	-,313 **
	Sig. (2-tailed)		,000	,000	,000	,000	,000
	N	371	213	365	370	369	371
BOD	Spearman Correlation	,818 **	1	,824 **	,389 **	,836 **	-,278 **
	Sig. (2-tailed)	,000		,000	,000	,000	,000
	N	213	213	212	212	212	213
SS	Spearman Correlation	,907 **	,824 **	1	,732 **	,701 **	-,142 **
	Sig. (2-tailed)	,000	,000		,000	,000	,007
	N	365	212	365	364	363	365
TP	SPearman Correlation	,708 **	,389 **	,732 **	1	,517 **	-,181 **
	Sig. (2-tailed)	,000	,000	,000		,000	,000
	N	370	212	364	371	368	371
TN	SPearman Correlation	,779 **	,836 **	,701 **	,517 **	1	-,576 **
	Sig. (2-tailed)	,000	,000	,000	,000		,000
	N	369	212	363	368	369	369
FLOW	Pearson Correlation	-,313 **	-,278 **	-,142 **	-,181 **	-,576 **	1
	Sig. (2-tailed)	,000	,000	,007	,000	,000	
	N	371	213	365	371	369	431

**. Correlation is significant at the 0.01 level (2-tailed).

Table 3.41 Correlation Analysis table of FWWTP effluent data

Correlations

		COD	BOD	SS	TP	TN	FLOW
COD	Spearman Correlation	1	,598 **	,337 **	-,133 *	-,303 **	-,305 **
	Sig. (2-tailed)		,000	,000	,012	,000	,000
	N	371	214	369	355	371	371
BOD	Spearman Correlation	,598 **	1	,341 **	-,189 **	-,152 *	-,408 **
	Sig. (2-tailed)	,000		,000	,007	,026	,000
	N	214	214	214	205	214	214
SS	Spearman Correlation	,337 **	,341 **	1	-,068	-,017	-,293 **
	Sig. (2-tailed)	,000	,000		,202	,749	,000
	N	369	214	369	353	369	369
TP	Spearman Correlation	-,133 *	-,189 **	-,068	1	,114 *	,164 **
	Sig. (2-tailed)	,012	,007	,202		,032	,002
	N	355	205	353	356	356	356
TN	Spearman Correlation	-,303 **	-,152 *	-,017	,114 *	1	-,001
	Sig. (2-tailed)	,000	,026	,749	,032		,991
	N	371	214	369	356	372	372
FLOW	Spearman Correlation	-,305 **	-,408 **	-,293 **	,164 **	-,001	1
	Sig. (2-tailed)	,000	,000	,000	,002	,991	
	N	371	214	369	356	372	431

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

3.19 Scatter graphics of FWWTP’s inluent and effluent data

Scatter graphics are prepeared for 627 data and 10 variables of FWWTP’ s influent and effluent data The weak association are obtained between COD-BOD, COD-TN, TP-SS values. We can see correlation coefficients of FWWTP’s influent data at Table 3.42 and when we compare graphics and this table, we got same result both graphics and table about association between variable. But we don’t observe same relations on graphics of FWWTP’s effluent values because of signicificant values is greater than 0.05. It means that these result are not significant statistically.

Table 3.42 Correlation coefficients of FWWTP’s influent data

	COD-BOD	COD-TN	COD-SS	BOD-SS	TP-SS	COD-TP	SS-TN
Correlation coef.	0.818	0.779	0.907	0.824	0.732	0.708	0.701
sig	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 3.43 Correlation coefficients of FWWTP’s effluent data

	COD-BOD	COD-SS	BOD-SS
Correlation coef.	0.598	0.337	0.341
sig	0.000	0.000	0.000

Table 3.44 Correlation coefficients of IMWWTP’s effluent data

	IQCOD-EQCOD	IQBOD-EQBOD	IQSS-EQSS	IQTN-EQTN	IQTP-EQTP
Correlation coef.	0.226	0.233	0.234	0.518	0.773
sig	0.000	0.001	0.001	0.000	0.000

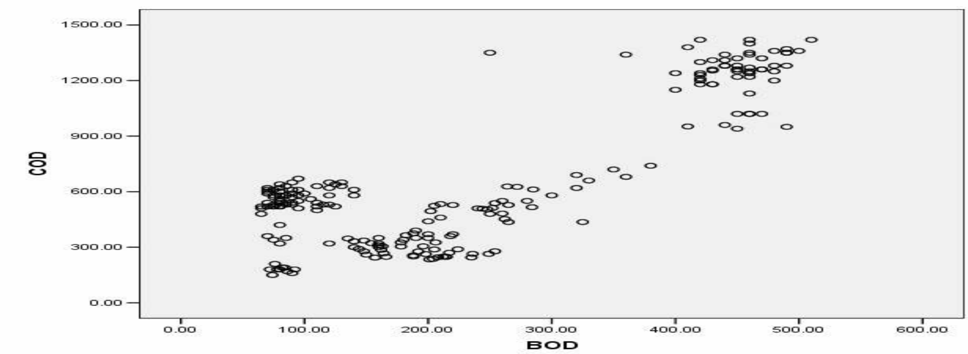


Figure 3.200 Scatter graphic of FWWTP’ s influent COD-BOD data

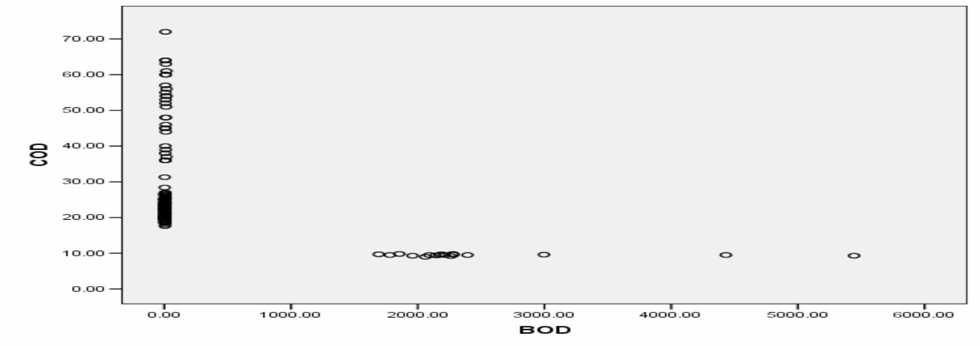


Figure 3.201 Scatter graphic of FWWTP effluent COD-BOD data

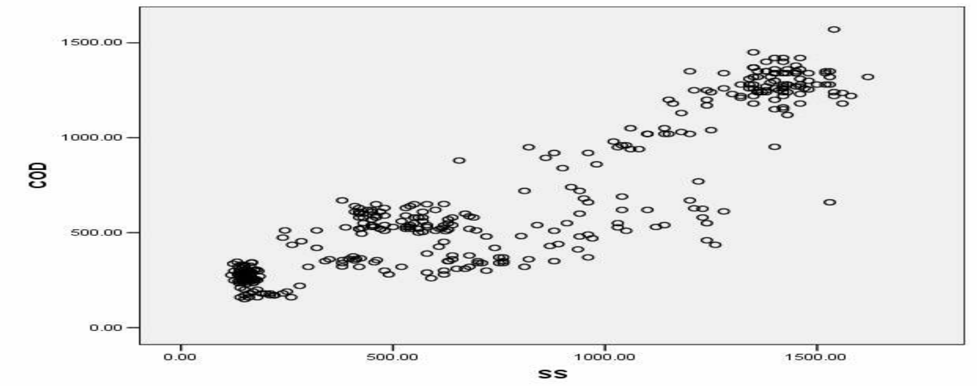


Figure 3.202 Scatter graphic of FWWTP influent COD-SS data

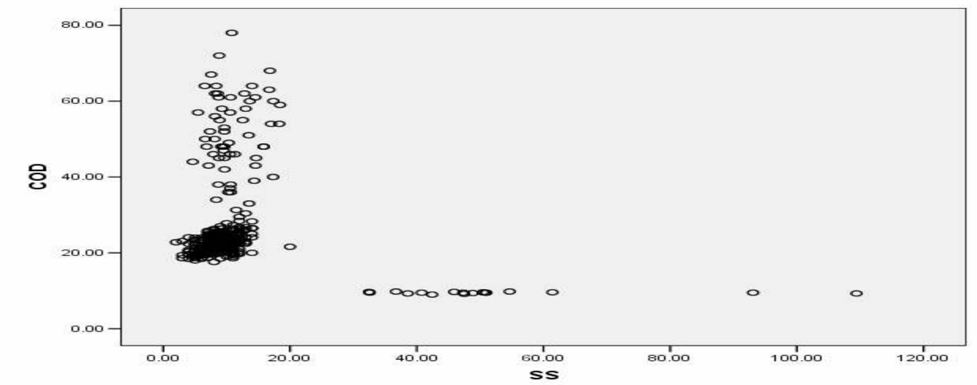


Figure 3.203 Scatter graphic of FWWTP effluent COD-SS data

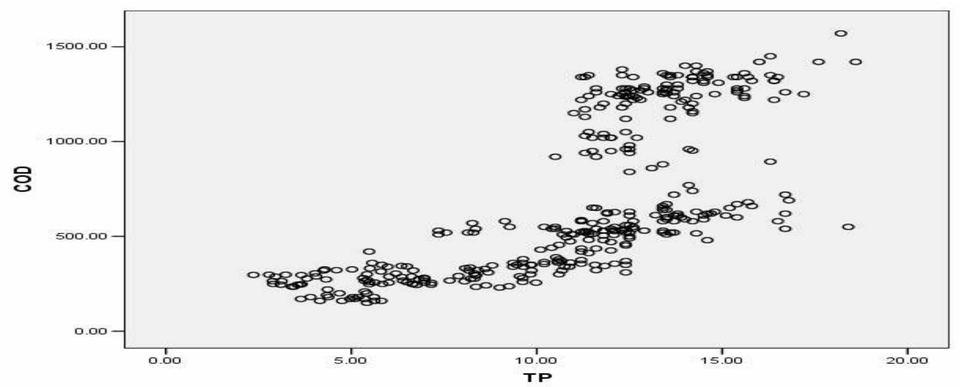


Figure 3.204 Scatter graphic of FWWTP influent COD-TP data

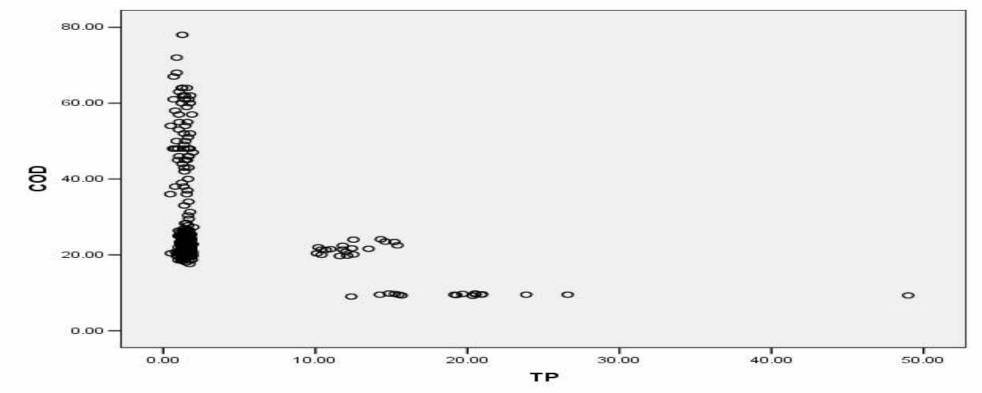


Figure 3.205 Scatter graphic of FWWTP effluent COD-TP data

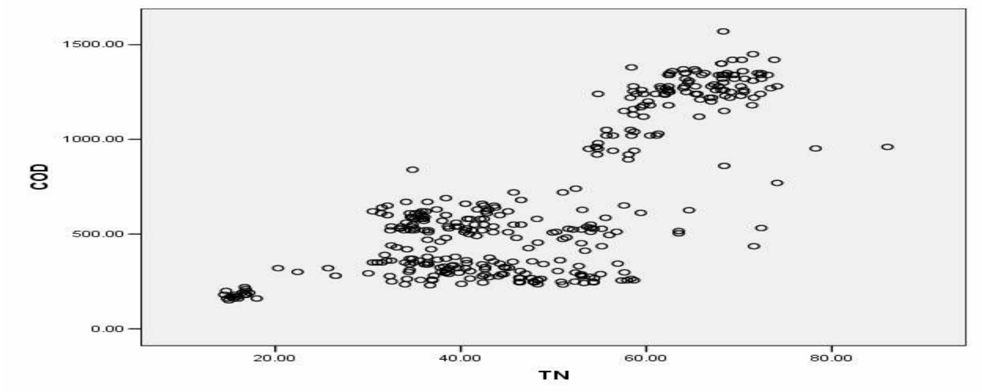


Figure 3.206 Scatter graphic of FWWTP influent COD-TN data

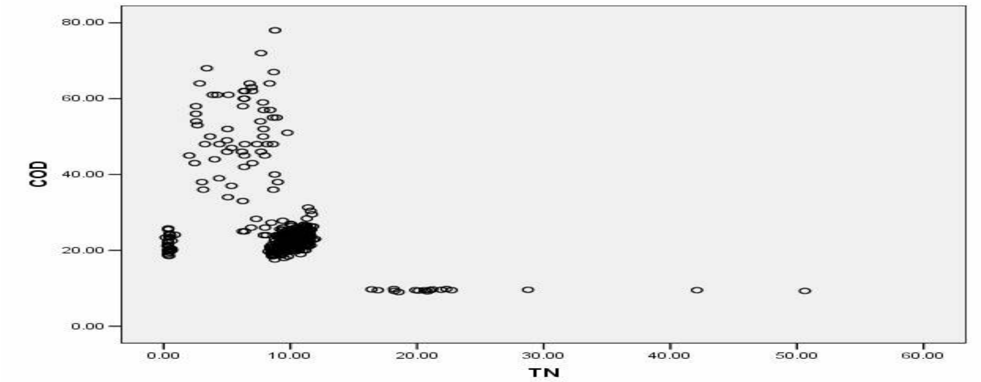


Figure 3.207 Scatter graphic of FWWTP effluent COD-TN data

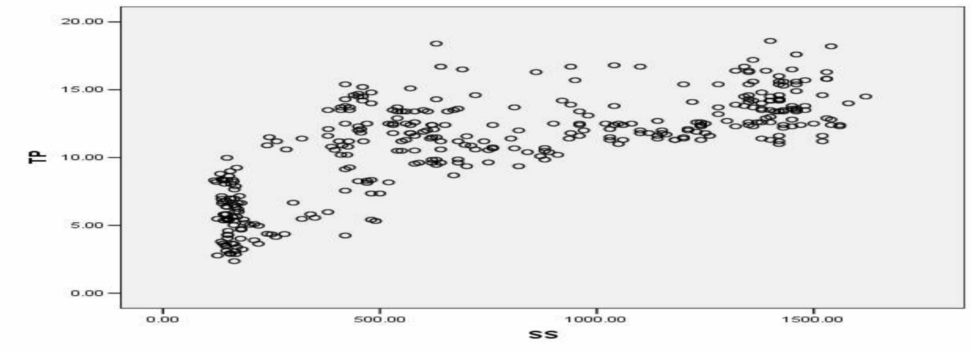


Figure 3.208 Scatter graphic of FWWTP influent TP-SS data

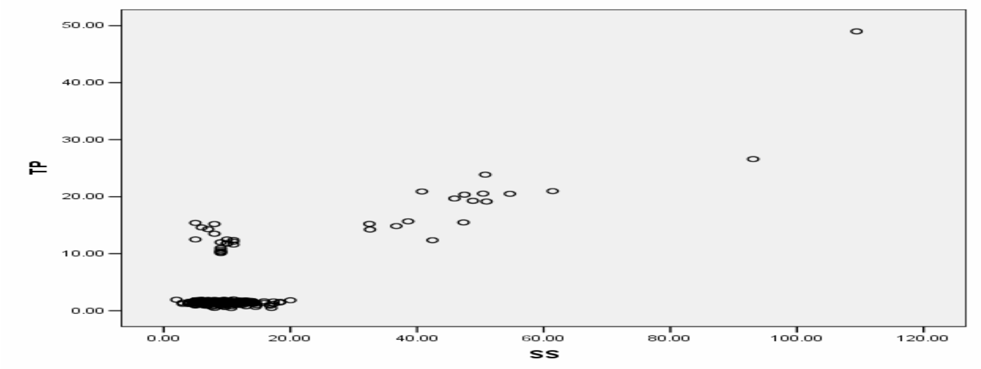


Figure 3.209 Scatter graphic of FWWTP effluent TP-SS data

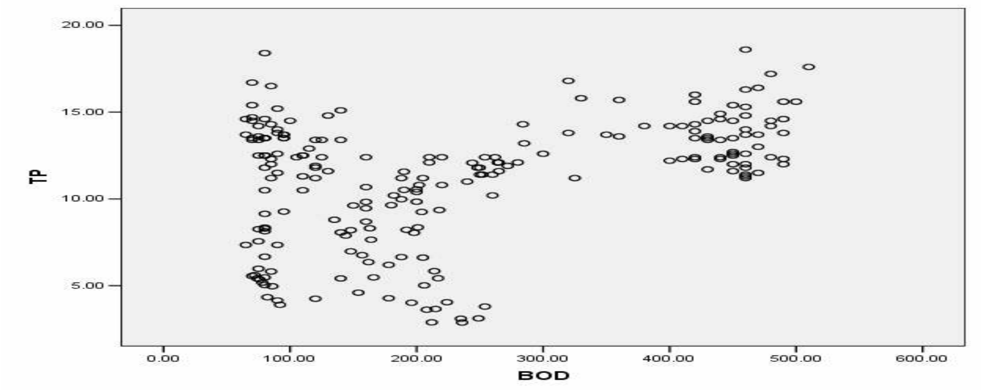


Figure 3.210 Scatter graphic of FWWTP influent TP-BOD data

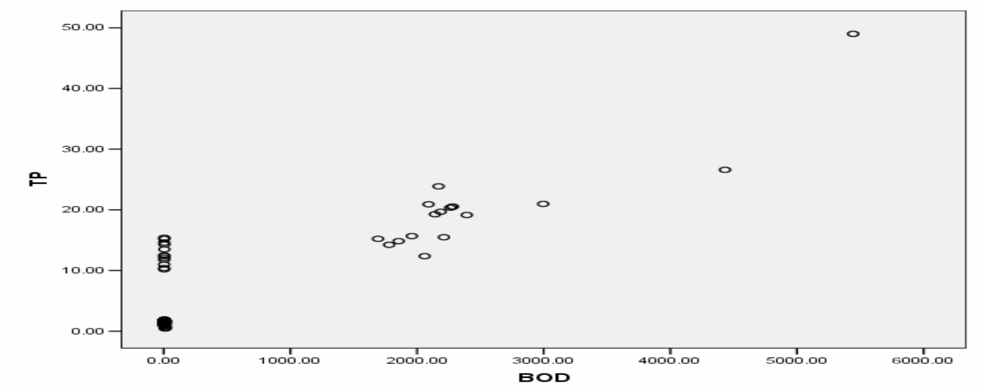


Figure 3.211 Scatter graphic of FWWTP effluent TP-BOD data

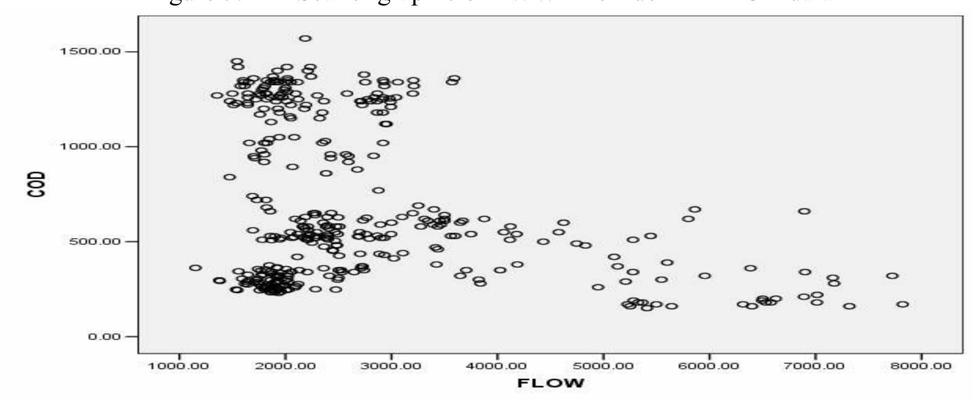


Figure 3.212 Scatter graphic of FWWTP influent COD-FLOW data

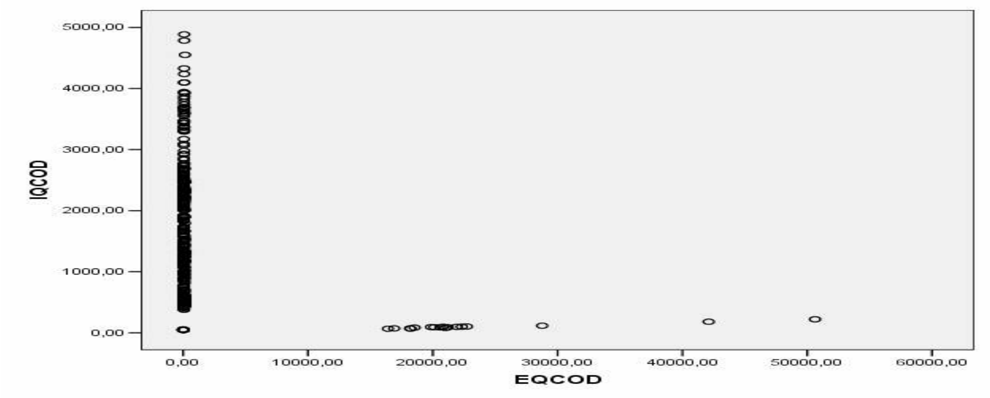


Figure 3.213 Scatter graphic of FWWTP IQCOD-EQCOD data

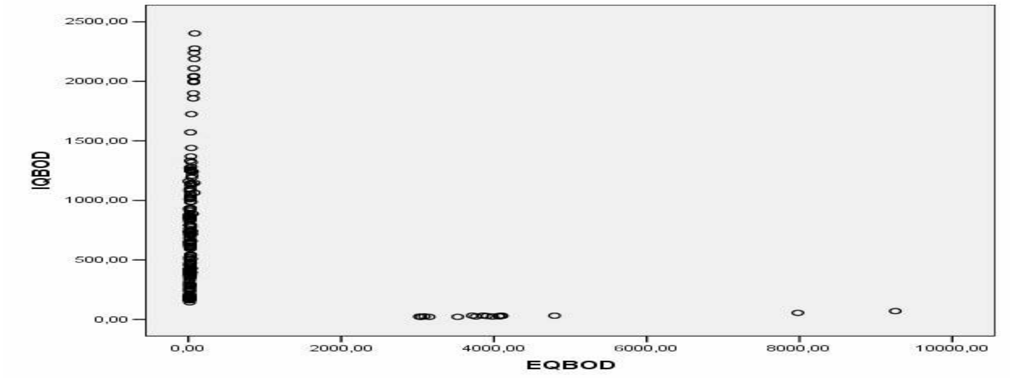


Figure 3.214 Scatter graphic of FWWTP IQBOD-EQBOD data

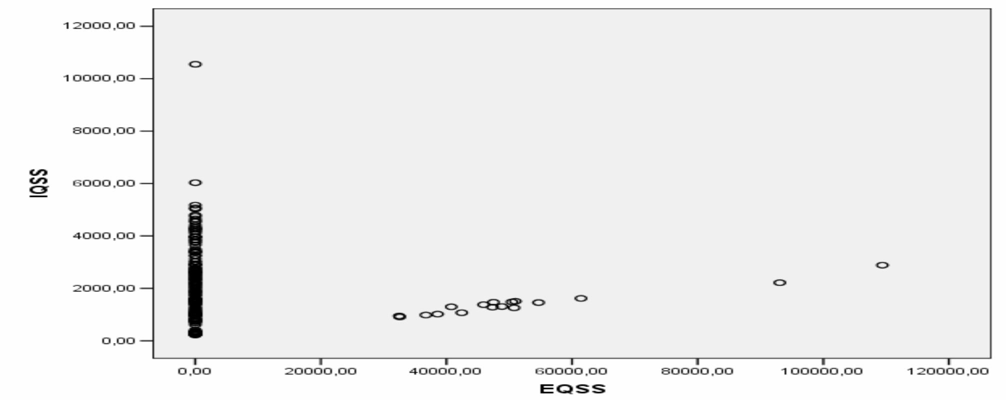


Figure 3.215 Scatter graphic of FWWTP IQSS-EQSS data

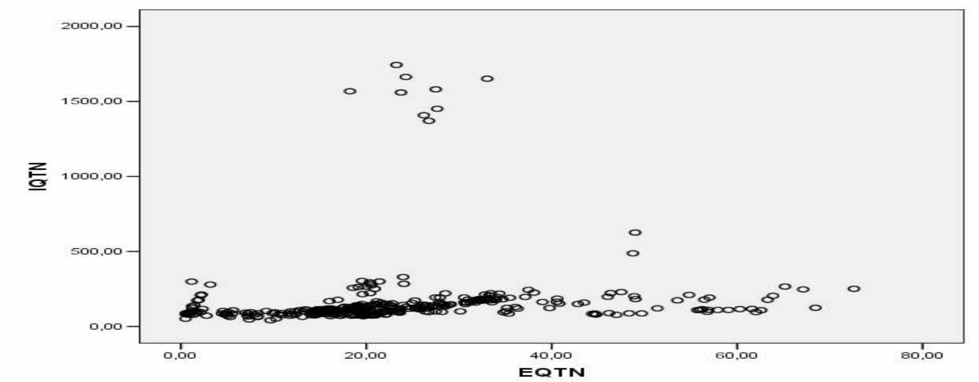


Figure 3.216 Scatter graphic of FWWTP IQSS-EQSS data

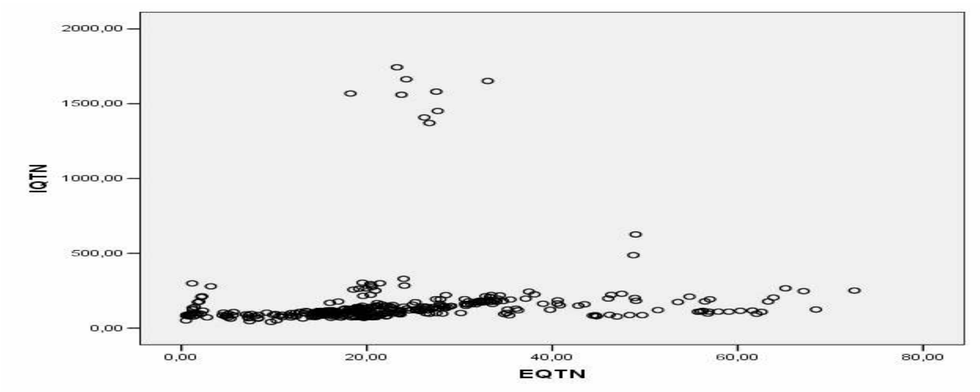


Figure 3.217 Scatter graphic of FWWTP IQTN-EQTN data

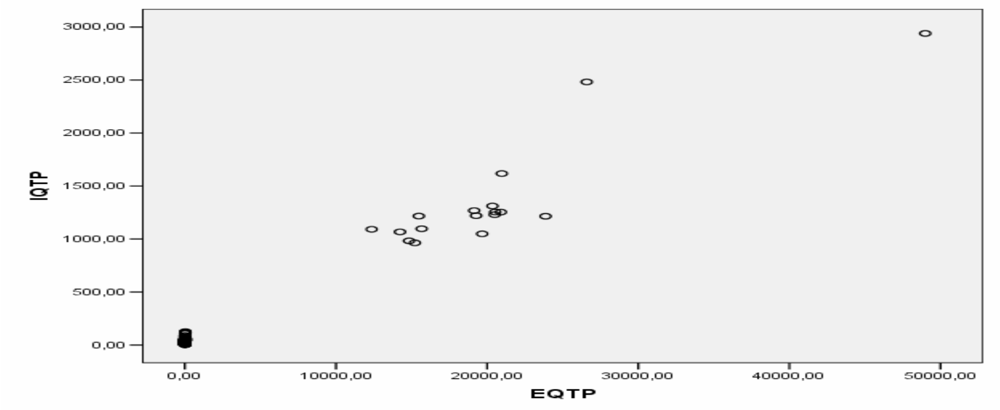


Figure 3.218 Scatter graphic of FWWTP IQTP-EQTP data

3.20 Regression analysis of FWWTP's data

Ho= There is a relation between variables
H1= There is no any relation between variables

According to Table 3.45, correlation coefficient is 0.925, r square is 0.856, which shows that the independent values are describing 92 % of the variation for the dependent variable COD. There is a very strong relation between dependent variable COD and other variable. At Table 3.46 Anova test showed that significant 0.00. Which means the model is significant. At Table 3.43 BOD, SS, TP, FLOW's sig. value < 0.05. Which mean is regression coefficient is significant and H1 hypothesis is valid so there is no any relation between COD-BOD, COD-SS, COD-TP COD-Flow. Also there is a relation between COD-TN.

Table 3.45 Model Summary of FWWTP's influent values

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,925[a]	,856	,852	146,45149

a. Predictors: (Constant), FLOW, SS, TP, TN, BOD

Table 3.46 ANOVA analyses of FWWTP's influent values

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	26010371	5	5202074,251	242,543	,000[a]
	Residual	4375400	204	21448,040		
	Total	30385771	209			

a. Predictors: (Constant), FLOW, SS, TP, TN, BOD

b. Dependent Variable: COD

Table 3.47 Coefficients of FWWTP's influent values

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	12,721	83,121		,153	,879
	BOD	,623	,173	,241	3,612	,000
	SS	,433	,054	,524	7,995	,000
	TP	19,303	4,228	,181	4,566	,000
	TN	1,436	1,709	,054	,841	,402
	FLOW	-,033	,011	-,108	-2,916	,004

a. Dependent Variable: COD

According to Table 3.48, correlation coefficient is 0.658, r square is 0.432, which shows that the independent values are describing 66 % of the variation for the dependent variable COD. There is a very strong relation between dependent variable COD and other variables. At Table 3.49 Anova test showed that significant 0.00. Which means the model is significant. At Table 3.50 just SS, BOD, TN variables and their models are significant because of sig.values < 0.05 and there is no any relation them with COD. But TP and Flow's $p<0.05$ and There is a relation with COD.

Table 3.48 Model Summary of FWWTP's effluent values

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,658[a]	,432	,418	7,93610

a. Predictors: (Constant), FLOW, TN, TP, SS, BOD

Table 3.49 ANOVA analyses of FWWTP's effluent values

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	9546,646	5	1909,329	30,316	,000[a]
	Residual	12533,362	199	62,982		
	Total	22080,008	204			

a. Predictors: (Constant), FLOW, TN, TP, SS, BOD

b. Dependent Variable: COD

Table 3.50 Coefficient of FWWTP's effluent values

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	14,604	3,515		4,155	,000
	BOD	1,700	,225	,468	7,542	,000
	SS	,900	,220	,237	4,090	,000
	TP	,094	,211	,024	,444	,658
	TN	-,671	,204	-,178	-3,290	,001
	FLOW	,000	,000	-,047	-,804	,422

a. Dependent Variable: COD

3.21 Boxplot of FWWTP values

Box plot graphic allows us to see the extreme values. These data which are at Table 3.51 and Table 3.52 are prepared according to box plot graphics... These data are extreme values because of this they should be removed or the data should be transformed.

Table 3.51 Extreme values of FWWTP's influent value

QTN	QCOD	QBOD	QTP
22/12/2004	17/11/2004	22/12/2004	22/12/2005
28/1/2005	22/12/2004	24/12/2004	24/12/2004
31/12/2004	15/11/2004	17/11/2004	25/11/2005
31/1/2005	11/8/2004		4/2/2005

Table 3.52 Extreme values of FWWTP's effluent value

COD	BOD	SS	TP	TN	QTN	QCOD	QBOD	QTP
24/3/2004	29/4/2004	7/5/2004	26/7/2005	1/5/2004	28/1/2005	28/1/2005	17/11/2004	31/12/2004
14/3/2004	6/4/2004	22/4/2004	22/7/2005	29/4/2004	4/2/2005	18/2/2005		22/7/2005
6/4/2004	4/4/2004		19/7/2005	18/4/2004	7/2/2005	7/2/2005		15/7/2005
4/4/2004			29/7/2005	6/4/2004	28/2/2005	22/12/2004		19/7/2005
5/5/2004			31/12/2004	31/3/2004	2/3/2005	24/4/2004		29/7/2005
31/3/2004			5/1/2005	8/4/2004		28/2/2005		10/1/2005
9/5/2004			10/1/2005	17/1/2005				21/2/2005
18/3/2004			22/4/2005	12/1/2005				
16/3/2004								

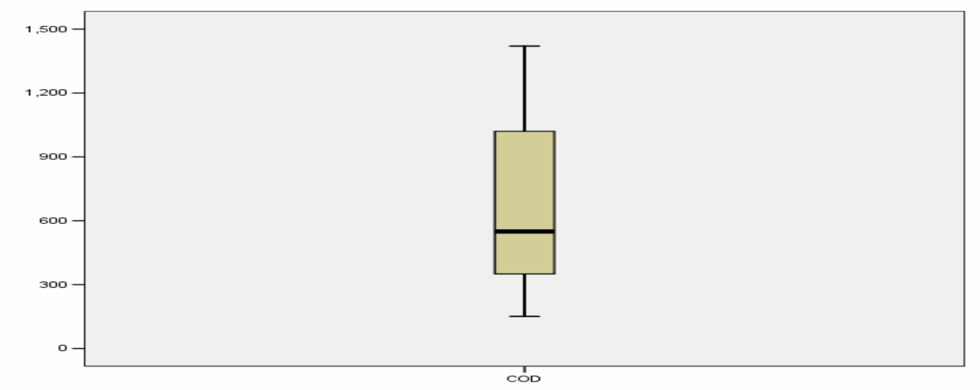


Figure 3.219 Boxplot graphic of FWWTP' s influent COD data

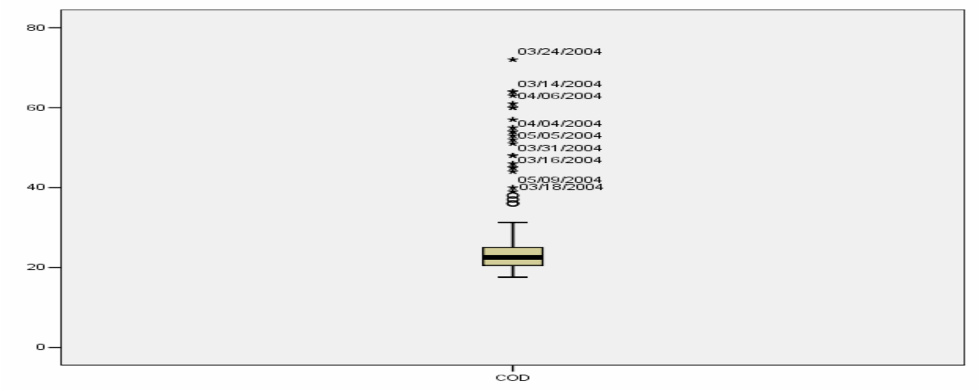


Figure 3.220 Boxplot graphic of FWWTP' s effluent COD data

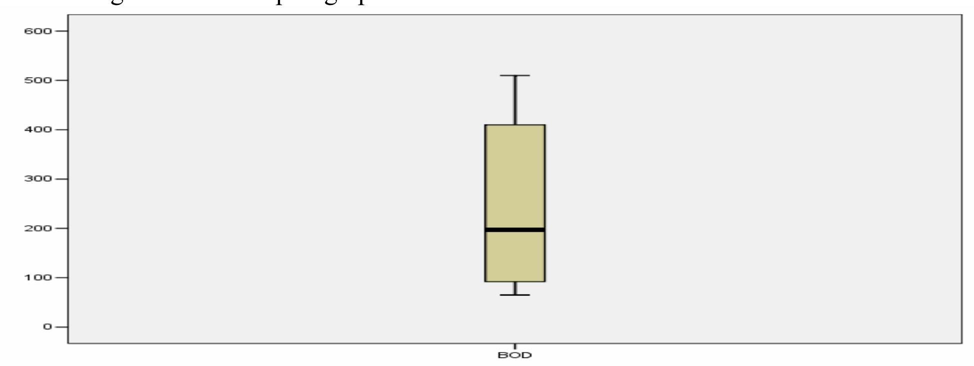


Figure 3.221 Boxplot graphic of FWWTP' s influent BOD data

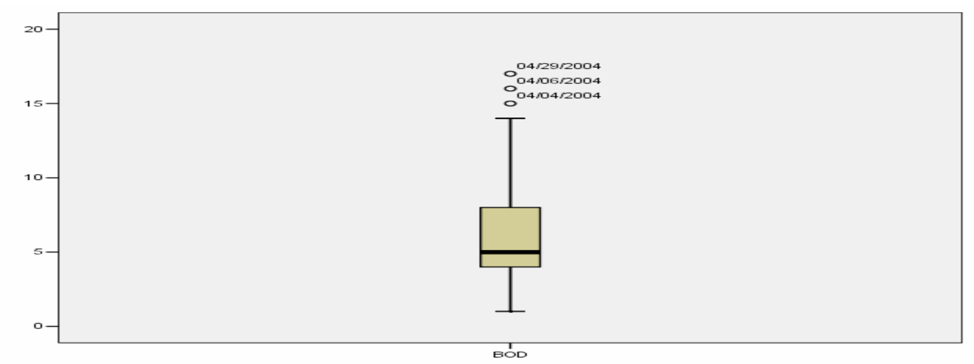


Figure 3.222 Boxplot graphic of FWWTP' s effluent BOD data

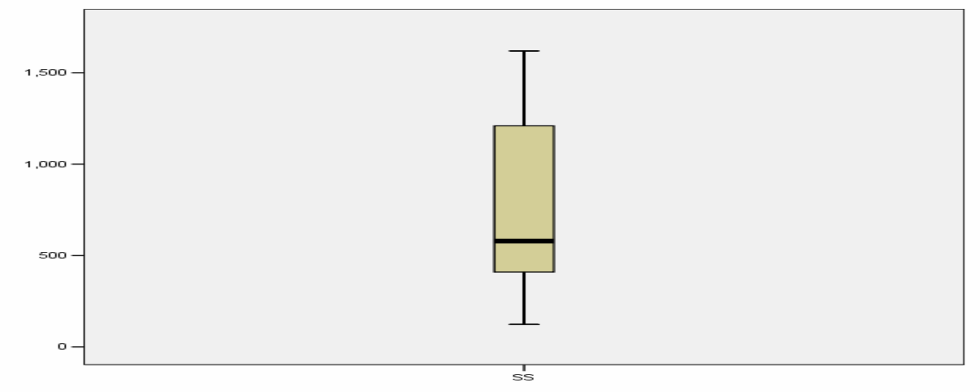


Figure 3.223 Boxplot graphic of FWWTP' s influent SS data

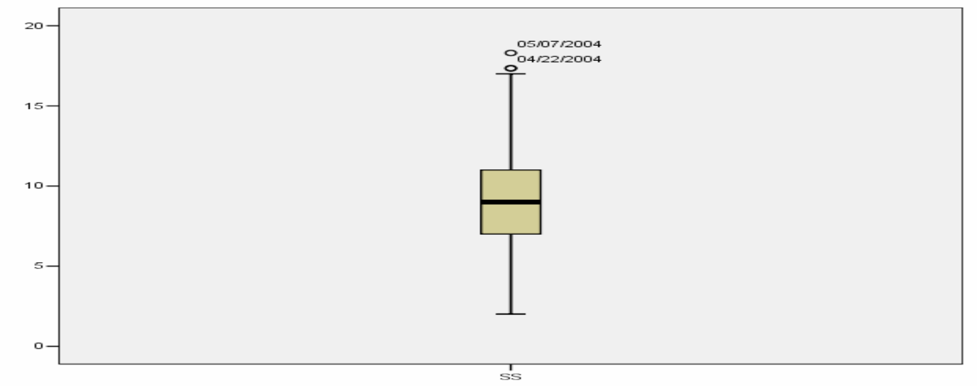


Figure 3.224 Boxplot graphic of FWWTP' s effluent SS data

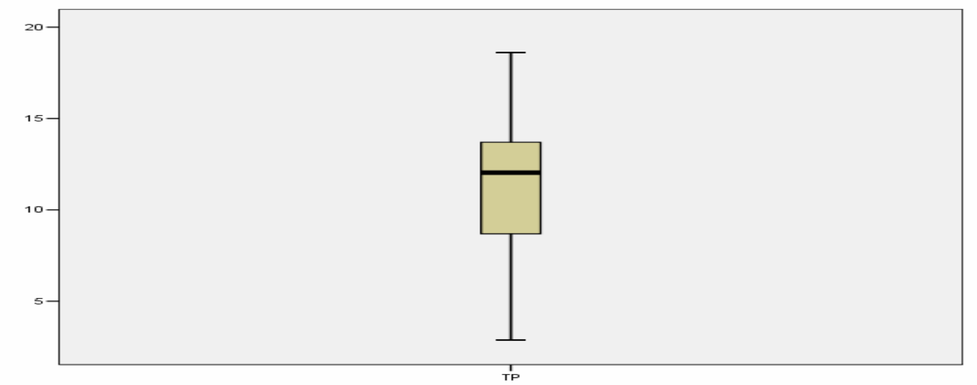


Figure 3.225 Boxplot graphic of FWWTP' s influent TP data

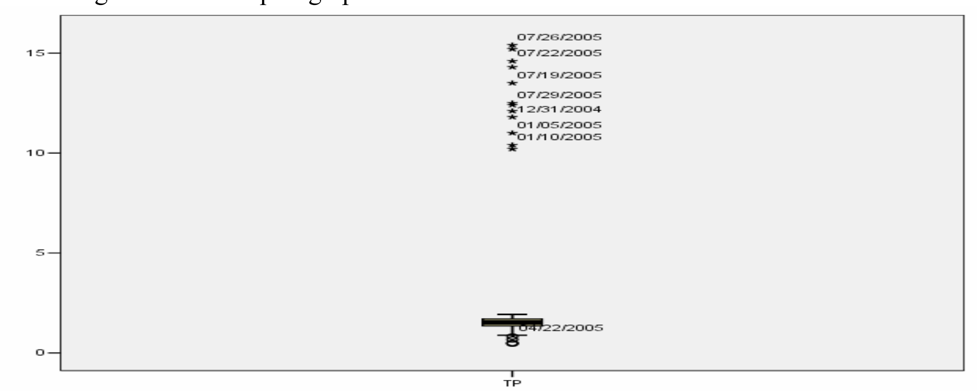


Figure 3.226 Boxplot graphic of FWWTP' s effluent TP data

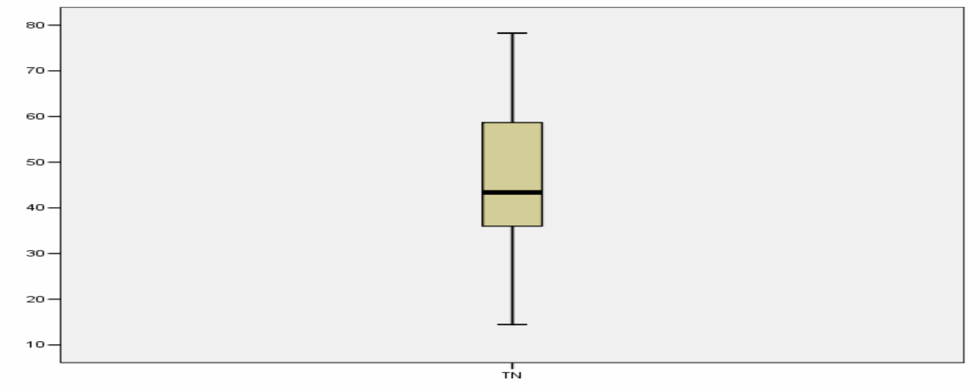


Figure 3.227 Boxplot graphic of FWWTP' s influent TN data

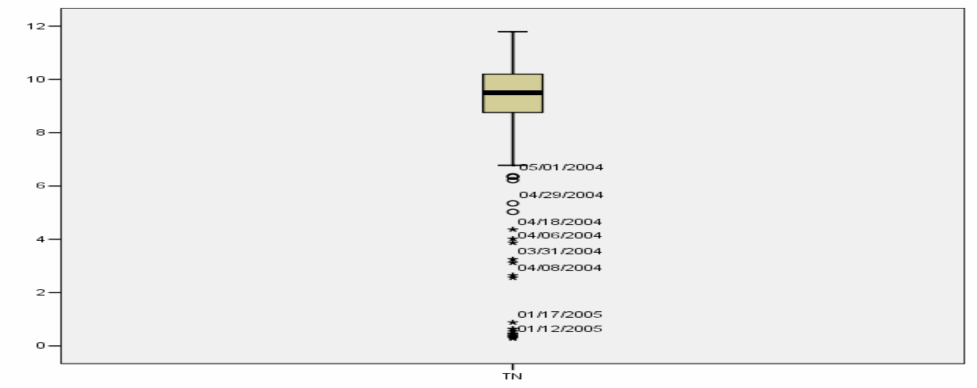


Figure 3.228 Boxplot graphic of FWWTP' s effluent TN data

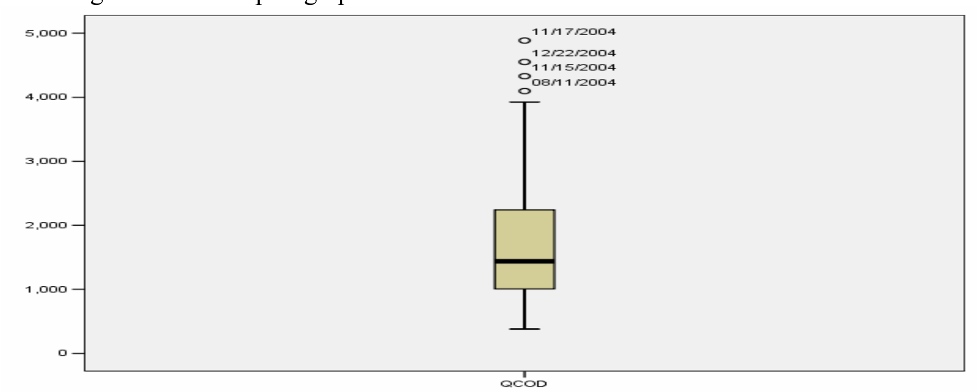


Figure 3.229 Boxplot graphic of FWWTP' s influent QCOD data

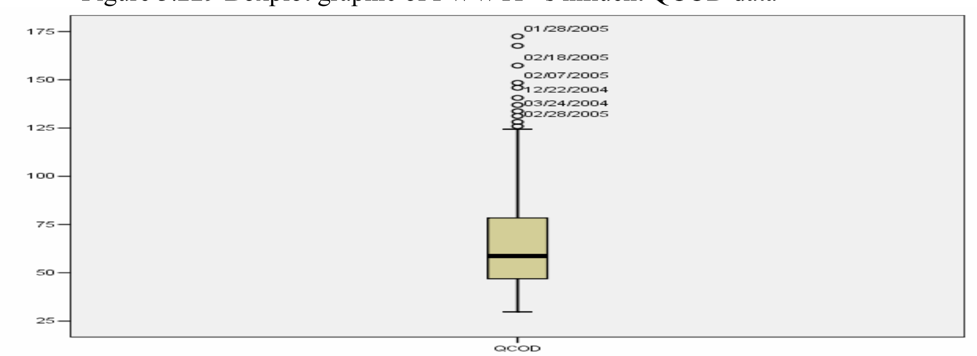


Figure 3.230 Boxplot graphic of FWWTP' s effluent QCOD data

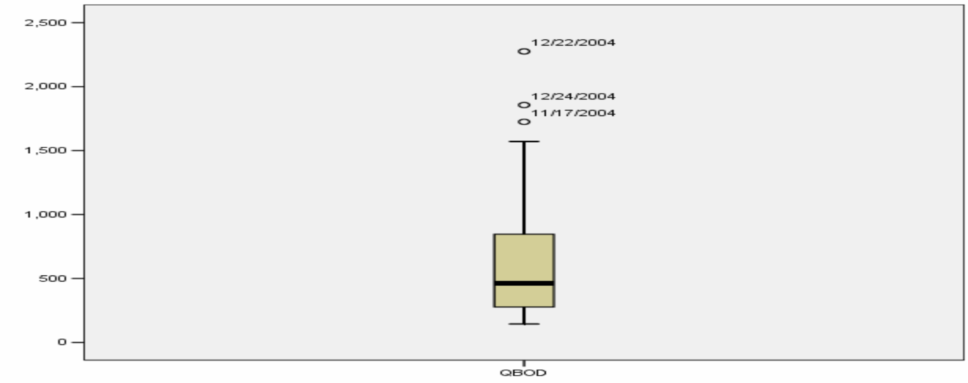


Figure 3.231 Boxplot graphic of FWWTP' s influent QBOD data

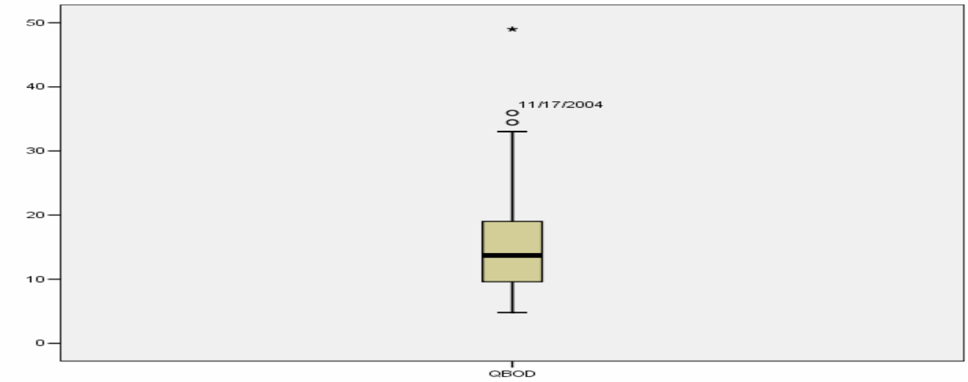


Figure 3.232 Boxplot graphic of FWWTP' s effluent QBOD data

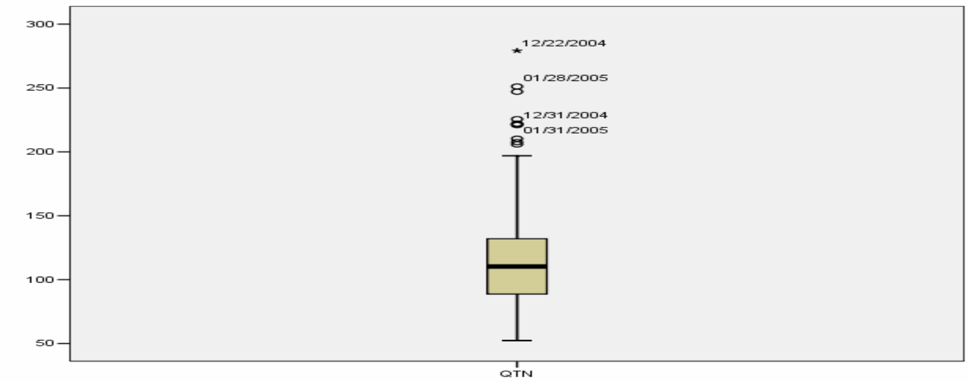


Figure 3.233 Boxplot graphic of FWWTP' s influent QTN data

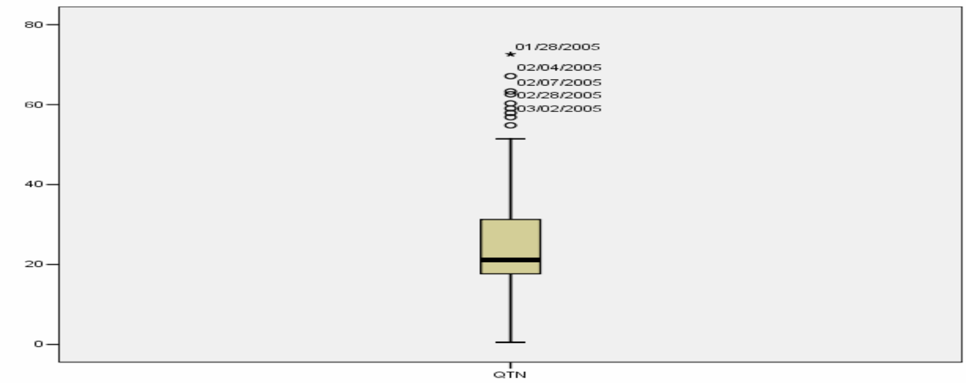


Figure 3.234 Boxplot graphic of FWWTP' s effluent QTN data

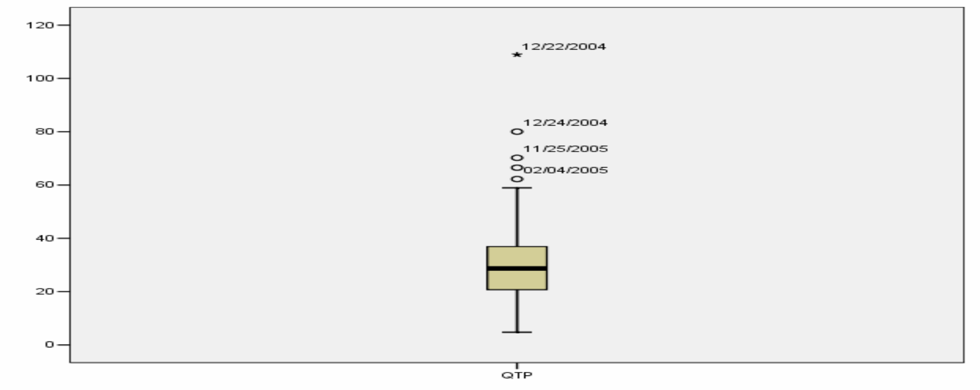


Figure 3.235 Boxplot graphic of FWWTP' s influent QTP data

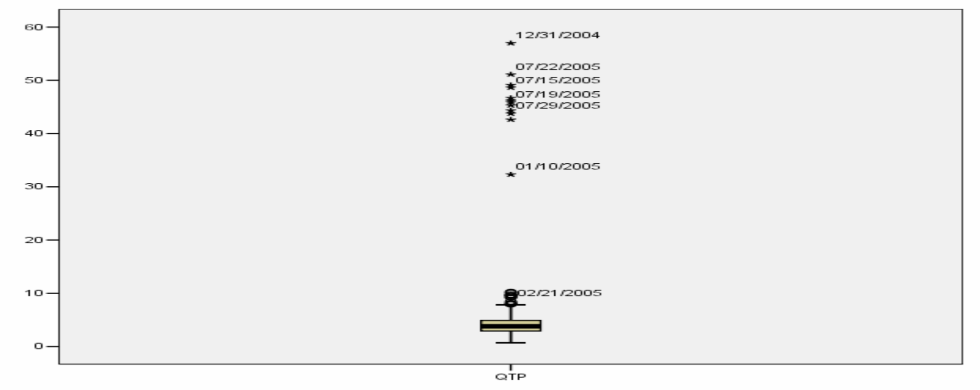


Figure 3.236 Boxplot graphic of FWWTP' s effluent QTP data

3.22 Variance Analysis (ANOVA)

Analysis of variance is a general method for studying sampled-data relationships. The method enables the difference between two or more sample means to be analysed, achieved by subdividing the total sum of squares. COD, BOD_5, SS, TP, TN parameters of WWTP are analyzed by ANOVA in order to. check differences between WWWTP's data. WWTP's data are selected as dependent variable. Number 1 is given to IMWWTP data on column of SPSS data page, number 2 is given to GWWTP and number 3 is given to FWWTP data as given on Table 3.60.

Ho= Variable's mean are same

H1= Variable's mean are not same.

For p=0.05 significant value When the p<0.05 H1 hypothesis is valid. Opposite Ho hypothesis is valid.

COD, BOD_5, SS, TP and TN variables homogeneity is investigated and all the significant values is found $p<0.05$. In this case Ho hypothesis is rejected. It's means their variances are not homogeny and equal. At ANOVA test, sig. values of all ANOVA tables are 0.00. Its means there is a difference between influent load of WWTP s such as COD, BOD, SS, TP, TP. Tukey, Sheffe and Bonferroni tests give differences between two variable. The comparison table of variable give that influent load of WWTP are differ significantly. On the Table 3.76 Tukey test gives significant value as 0.941 between IMWWTP and GWWTP, Sheffe test gives it as 0.946 between IMWWTP and GWWTP, Bonferroni test gives also it as 1. Whole significant values of SS between both WWTP are > 0.05. It's mean that there is no any difference for SS mean value of IMWWTP and GWWTP.

Table 3.53 Test of Homogeneity of three WWTP's influent COD variances

Test of Homogeneity of Variances

WWTP

Levene Statistic	df1	df2	Sig.
544,741	2	1981	,000

Table 3.54 ANOVA test of three WWTP's influent COD variances

ANOVA

WWTP

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	40148832	2	20074416,19	374,387	,000
Within Groups	1E+008	1981	53619,358		
Total	1E+008	1983			

Table 3.55 Comparison of three WWTP's influent BOD variances

Multiple Comparisons

Dependent Variable: WWTP

	(I) VAR00001	(J) VAR00001	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tukey HSD	1	2	71,22349*	12,09068	,000	42,8652	99,5818
		3	-331,38228*	13,98718	,000	-364,1888	-298,5758
	2	1	-71,22349*	12,09068	,000	-99,5818	-42,8652
		3	-402,60577*	15,47890	,000	-438,9110	-366,3005
	3	1	331,38228*	13,98718	,000	298,5758	364,1888
		2	402,60577*	15,47890	,000	366,3005	438,9110
Scheffe	1	2	71,22349*	12,09068	,000	41,6062	100,8408
		3	-331,38228*	13,98718	,000	-365,6453	-297,1193
	2	1	-71,22349*	12,09068	,000	-100,8408	-41,6062
		3	-402,60577*	15,47890	,000	-440,5229	-364,6887
	3	1	331,38228*	13,98718	,000	297,1193	365,6453
		2	402,60577*	15,47890	,000	364,6887	440,5229
Bonferroni	1	2	71,22349*	12,09068	,000	42,2540	100,1929
		3	-331,38228*	13,98718	,000	-364,8958	-297,8688
	2	1	-71,22349*	12,09068	,000	-100,1929	-42,2540
		3	-402,60577*	15,47890	,000	-439,6934	-365,5181
	3	1	331,38228*	13,98718	,000	297,8688	364,8958
		2	402,60577*	15,47890	,000	365,5181	439,6934

*. The mean difference is significant at the .05 level.

Table 3.56 Test of Homogeneity of three WWTP's influent BOD variances

Test of Homogeneity of Variances

IMWWTP

Levene Statistic	df1	df2	Sig.
88,783	2	1530	,000

Table 3.57 ANOVA test of three WWTP's influent BOD variances

ANOVA

IMWWTP

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2637622	2	1318811,226	129,429	,000
Within Groups	15589915	1530	10189,487		
Total	18227537	1532			

Table 3.58 Comparison of three WWTP's influent BOD variances

Multiple Comparisons

Dependent Variable: IMWWTP

	(I) VAR00001	(J) VAR00001	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tukey HSD	1	2	74,00316*	5,57542	,000	60,9233	87,0830
		3	-33,80178*	7,88092	,000	-52,2903	-15,3132
	2	1	-74,00316*	5,57542	,000	-87,0830	-60,9233
		3	-107,80494*	8,04067	,000	-126,6682	-88,9416
	3	1	33,80178*	7,88092	,000	15,3132	52,2903
		2	107,80494*	8,04067	,000	88,9416	126,6682
Scheffe	1	2	74,00316*	5,57542	,000	60,3426	87,6638
		3	-33,80178*	7,88092	,000	-53,1112	-14,4924
	2	1	-74,00316*	5,57542	,000	-87,6638	-60,3426
		3	-107,80494*	8,04067	,000	-127,5057	-88,1041
	3	1	33,80178*	7,88092	,000	14,4924	53,1112
		2	107,80494*	8,04067	,000	88,1041	127,5057
Bonferroni	1	2	74,00316*	5,57542	,000	60,6410	87,3653
		3	-33,80178*	7,88092	,000	-52,6893	-14,9142
	2	1	-74,00316*	5,57542	,000	-87,3653	-60,6410
		3	-107,80494*	8,04067	,000	-127,0753	-88,5346
	3	1	33,80178*	7,88092	,000	14,9142	52,6893
		2	107,80494*	8,04067	,000	88,5346	127,0753

*. The mean difference is significant at the .05 level.

Table 3.59 Test of Homogeneity of three WWTP's influent SS variances

Test of Homogeneity of Variances

WWTP

Levene Statistic	df1	df2	Sig.
443,236	2	1932	,000

Table 3.60 ANOVA test of three WWTP's influent SS variances

ANOVA

WWTP

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	99563664	2	49781831,89	964,581	,000
Within Groups	1E+008	1987	51609,799		
Total	2E+008	1989			

Table 3.61 Comparison of three WWTP's influent SS variances

Multiple Comparisons

Dependent Variable: WWTP

	(I) VAR00001	(J) VAR00001	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Tukey HSD	1	2	49,02595*	11,27913	,000	22,5712	75,4807
		3	-551,53820*	14,23441	,000	-584,9245	-518,1520
	2	1	-49,02595*	11,27913	,000	-75,4807	-22,5712
		3	-600,56415*	14,40118	,000	-634,3416	-566,7867
	3	1	551,53820*	14,23441	,000	518,1520	584,9245
		2	600,56415*	14,40118	,000	566,7867	634,3416
Scheffe	1	2	49,02595*	11,27913	,000	21,3967	76,6552
		3	-551,53820*	14,23441	,000	-586,4067	-516,6697
	2	1	-49,02595*	11,27913	,000	-76,6552	-21,3967
		3	-600,56415*	14,40118	,000	-635,8412	-565,2871
	3	1	551,53820*	14,23441	,000	516,6697	586,4067
		2	600,56415*	14,40118	,000	565,2871	635,8412
Bonferroni	1	2	49,02595*	11,27913	,000	22,0010	76,0508
		3	-551,53820*	14,23441	,000	-585,6440	-517,4324
	2	1	-49,02595*	11,27913	,000	-76,0508	-22,0010
		3	-600,56415*	14,40118	,000	-635,0695	-566,0588
	3	1	551,53820*	14,23441	,000	517,4324	585,6440
		2	600,56415*	14,40118	,000	566,0588	635,0695

*. The mean difference is significant at the .05 level.

Table 3.62 Test of Homogeneity of three WWTP's influent TP variances

Test of Homogeneity of Variances

WWTP

Levene Statistic	df1	df2	Sig.
443,236	2	1932	,000

Table 3.63 ANOVA test of three WWTP's influent TP variances

ANOVA

WWTP

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	18900,115	2	9450,057	150,813	,000
Within Groups	121060,4	1932	62,661		
Total	139960,5	1934			

Table 3.64 Comparison of three WWTP's influent TP variances

Multiple Comparisons

Dependent Variable: WWTP

	(I) VAR00001	(J) VAR00001	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
Tukey HSD	1	2	-6,96486*	,40111	,000	-7,9057	-6,0240
		3	-3,10636*	,49427	,000	-4,2657	-1,9471
	2	1	6,96486*	,40111	,000	6,0240	7,9057
		3	3,85849*	,50436	,000	2,6755	5,0415
	3	1	3,10636*	,49427	,000	1,9471	4,2657
		2	-3,85849*	,50436	,000	-5,0415	-2,6755
Scheffe	1	2	-6,96486*	,40111	,000	-7,9474	-5,9823
		3	-3,10636*	,49427	,000	-4,3171	-1,8956
	2	1	6,96486*	,40111	,000	5,9823	7,9474
		3	3,85849*	,50436	,000	2,6230	5,0940
	3	1	3,10636*	,49427	,000	1,8956	4,3171
		2	-3,85849*	,50436	,000	-5,0940	-2,6230
Bonferroni	1	2	-6,96486*	,40111	,000	-7,9259	-6,0038
		3	-3,10636*	,49427	,000	-4,2907	-1,9221
	2	1	6,96486*	,40111	,000	6,0038	7,9259
		3	3,85849*	,50436	,000	2,6500	5,0670
	3	1	3,10636*	,49427	,000	1,9221	4,2907
		2	-3,85849*	,50436	,000	-5,0670	-2,6500

*. The mean difference is significant at the .05 level.

Table 3.65 Test of Homogeneity of three WWTP's influent TN variances

Test of Homogeneity of Variances

WWTP

Levene Statistic	df1	df2	Sig.
61,769	2	2069	,000

Table 3.66 ANOVA test of three WWTP's influent TN variances

ANOVA

WWTP

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	332720,6	2	166360,304	1135,033	,000
Within Groups	303250,6	2069	146,569		
Total	635971,2	2071			

Table 3.67 Comparison of three WWTP's influent TN variances

Multiple Comparisons

Dependent Variable: WWTP

	(I) VAR00001	(J) VAR00001	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
Tukey HSD	1	2	21,97117*	,59501	,000	20,5756	23,3667
		3	-11,77109*	,73811	,000	-13,5022	-10,0399
	2	1	-21,97117*	,59501	,000	-23,3667	-20,5756
		3	-33,74226*	,77694	,000	-35,5645	-31,9200
	3	1	11,77109*	,73811	,000	10,0399	13,5022
		2	33,74226*	,77694	,000	31,9200	35,5645
Scheffe	1	2	21,97117*	,59501	,000	20,5137	23,4287
		3	-11,77109*	,73811	,000	-13,5791	-9,9631
	2	1	-21,97117*	,59501	,000	-23,4287	-20,5137
		3	-33,74226*	,77694	,000	-35,6454	-31,8391
	3	1	11,77109*	,73811	,000	9,9631	13,5791
		2	33,74226*	,77694	,000	31,8391	35,6454
Bonferroni	1	2	21,97117*	,59501	,000	20,5456	23,3968
		3	-11,77109*	,73811	,000	-13,5395	-10,0026
	2	1	-21,97117*	,59501	,000	-23,3968	-20,5456
		3	-33,74226*	,77694	,000	-35,6038	-31,8808
	3	1	11,77109*	,73811	,000	10,0026	13,5395
		2	33,74226*	,77694	,000	31,8808	35,6038

*. The mean difference is significant at the .05 level.

Table 3.68 Test of Homogeneity of three WWTP's effluent COD variances

Test of Homogeneity of Variances

WWTP

Levene Statistic	df1	df2	Sig.
96,225	2	2017	,000

Table 3.69 ANOVA test of three WWTP's effluent COD variances

ANOVA

WWTP

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	220849,8	2	110424,895	204,954	,000
Within Groups	1086718	2017	538,779		
Total	1307568	2019			

Table 3.70 Comparison of three WWTP's effluent COD variances

Multiple Comparisons

Dependent Variable: WWTP

	(I) VAR00002	(J) VAR00002	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
Tukey HSD	1	2	2,916*	1,144	,029	,23	5,60
		3	28,208*	1,442	,000	24,82	31,59
	2	1	-2,916*	1,144	,029	-5,60	-,23
		3	25,292*	1,463	,000	21,86	28,72
	3	1	-28,208*	1,442	,000	-31,59	-24,82
		2	-25,292*	1,463	,000	-28,72	-21,86
Scheffe	1	2	2,916*	1,144	,039	,11	5,72
		3	28,208*	1,442	,000	24,67	31,74
	2	1	-2,916*	1,144	,039	-5,72	-,11
		3	25,292*	1,463	,000	21,71	28,88
	3	1	-28,208*	1,442	,000	-31,74	-24,67
		2	-25,292*	1,463	,000	-28,88	-21,71
Bonferroni	1	2	2,916*	1,144	,033	,17	5,66
		3	28,208*	1,442	,000	24,75	31,66
	2	1	-2,916*	1,144	,033	-5,66	-,17
		3	25,292*	1,463	,000	21,79	28,80
	3	1	-28,208*	1,442	,000	-31,66	-24,75
		2	-25,292*	1,463	,000	-28,80	-21,79

*. The mean difference is significant at the .05 level.

Table 3.71 Test of Homogeneity of three WWTP's effluent BOD variances

Test of Homogeneity of Variances

WWTP

Levene Statistic	df1	df2	Sig.
162,502	2	1515	,000

Table 3.72 ANOVA test of three WWTP's effluent BOD variances

ANOVA

WWTP

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	65628,357	2	32814,179	206,769	,000
Within Groups	240430,5	1515	158,700		
Total	306058,9	1517			

Table 3.73 Comparison of three WWTP's effluent BOD variances

Multiple Comparisons

Dependent Variable: WWTP

	(I) VAR00002	(J) VAR00002	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
Tukey HSD	1	2	11,763*	,699	,000	10,12	13,40
		3	16,909*	1,002	,000	14,56	19,26
	2	1	-11,763*	,699	,000	-13,40	-10,12
		3	5,146*	,985	,000	2,84	7,46
	3	1	-16,909*	1,002	,000	-19,26	-14,56
		2	-5,146*	,985	,000	-7,46	-2,84
Scheffe	1	2	11,763*	,699	,000	10,05	13,48
		3	16,909*	1,002	,000	14,45	19,36
	2	1	-11,763*	,699	,000	-13,48	-10,05
		3	5,146*	,985	,000	2,73	7,56
	3	1	-16,909*	1,002	,000	-19,36	-14,45
		2	-5,146*	,985	,000	-7,56	-2,73
Bonferroni	1	2	11,763*	,699	,000	10,09	13,44
		3	16,909*	1,002	,000	14,51	19,31
	2	1	-11,763*	,699	,000	-13,44	-10,09
		3	5,146*	,985	,000	2,79	7,51
	3	1	-16,909*	1,002	,000	-19,31	-14,51
		2	-5,146*	,985	,000	-7,51	-2,79

*. The mean difference is significant at the .05 level.

Table 3.74 Test of Homogeneity of three WWTP's effluent SS variances

Test of Homogeneity of Variances

WWTP

Levene Statistic	df1	df2	Sig.
115,877	2	2137	,000

Table 3.75 ANOVA test of three WWTP's effluent SS variances

ANOVA

WWTP

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	73498,042	2	36749,021	164,211	,000
Within Groups	478243,7	2137	223,792		
Total	551741,7	2139			

Table 3.76 Comparison of three Wit's effluent SS variances

Multiple Comparisons

Dependent Variable: WWTP

	(I) VAR00002	(J) VAR00002	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tukey HSD	1	2	,2383	,7152	,941	-1,439	1,916
		3	15,6175*	,9134	,000	13,475	17,760
	2	1	-,2383	,7152	,941	-1,916	1,439
		3	15,3792*	,9435	,000	13,166	17,592
	3	1	-15,6175*	,9134	,000	-17,760	-13,475
		2	-15,3792*	,9435	,000	-17,592	-13,166
Scheffe	1	2	,2383	,7152	,946	-1,514	1,990
		3	15,6175*	,9134	,000	13,380	17,855
	2	1	-,2383	,7152	,946	-1,990	1,514
		3	15,3792*	,9435	,000	13,068	17,690
	3	1	-15,6175*	,9134	,000	-17,855	-13,380
		2	-15,3792*	,9435	,000	-17,690	-13,068
Bonferroni	1	2	,2383	,7152	1,000	-1,475	1,952
		3	15,6175*	,9134	,000	13,429	17,806
	2	1	-,2383	,7152	1,000	-1,952	1,475
		3	15,3792*	,9435	,000	13,119	17,640
	3	1	-15,6175*	,9134	,000	-17,806	-13,429
		2	-15,3792*	,9435	,000	-17,640	-13,119

*. The mean difference is significant at the .05 level.

Table 3.77 Test of Homogeneity of three WWTP's effluent TP variances

Test of Homogeneity of Variances

WWTP

Levene Statistic	df1	df2	Sig.
30,986	2	1431	,000

Table 3.78 ANOVA test of three WWTP's effluent TP variances

ANOVA

WWTP

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3041,419	2	1520,710	463,489	,000
Within Groups	4695,119	1431	3,281		
Total	7736,538	1433			

Table 3.79 Comparison of three Wit's effluent TP variances

Multiple Comparisons

Dependent Variable: WWTP

	(I) VAR00002	(J) VAR00002	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
Tukey HSD	1	2	3,5188*	,1340	,000	3,204	3,833
		3	2,4678*	,1145	,000	2,199	2,736
	2	1	-3,5188*	,1340	,000	-3,833	-3,204
		3	-1,0510*	,1526	,000	-1,409	-,693
	3	1	-2,4678*	,1145	,000	-2,736	-2,199
		2	1,0510*	,1526	,000	,693	1,409
Scheffe	1	2	3,5188*	,1340	,000	3,190	3,847
		3	2,4678*	,1145	,000	2,187	2,748
	2	1	-3,5188*	,1340	,000	-3,847	-3,190
		3	-1,0510*	,1526	,000	-1,425	-,677
	3	1	-2,4678*	,1145	,000	-2,748	-2,187
		2	1,0510*	,1526	,000	,677	1,425
Bonferroni	1	2	3,5188*	,1340	,000	3,198	3,840
		3	2,4678*	,1145	,000	2,193	2,742
	2	1	-3,5188*	,1340	,000	-3,840	-3,198
		3	-1,0510*	,1526	,000	-1,417	-,685
	3	1	-2,4678*	,1145	,000	-2,742	-2,193
		2	1,0510*	,1526	,000	,685	1,417

*. The mean difference is significant at the .05 level.

Table 3.80 Test of Homogeneity of three WWTP's effluent TN variances

Test of Homogeneity of Variances

WWTP

Levene Statistic	df1	df2	Sig.
79,120	2	1601	,000

Table 3.81 Comparison of three WWTP's effluent TN variances

ANOVA

WWTP

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	18956,170	2	9478,085	674,534	,000
Within Groups	22496,159	1601	14,051		
Total	41452,329	1603			

Table 3.82 Comparison of three WWTP's effluent TN variances

Multiple Comparisons

Dependent Variable: WWTP

	(I) VAR00002	(J) VAR00002	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tukey HSD	1	2	8,0304*	,2204	,000	7,513	8,547
		3	1,9940*	,2368	,000	1,439	2,549
	2	1	-8,0304*	,2204	,000	-8,547	-7,513
		3	-6,0364*	,2609	,000	-6,648	-5,424
	3	1	-1,9940*	,2368	,000	-2,549	-1,439
		2	6,0364*	,2609	,000	5,424	6,648
Scheffe	1	2	8,0304*	,2204	,000	7,490	8,570
		3	1,9940*	,2368	,000	1,414	2,574
	2	1	-8,0304*	,2204	,000	-8,570	-7,490
		3	-6,0364*	,2609	,000	-6,676	-5,397
	3	1	-1,9940*	,2368	,000	-2,574	-1,414
		2	6,0364*	,2609	,000	5,397	6,676
Bonferroni	1	2	8,0304*	,2204	,000	7,502	8,559
		3	1,9940*	,2368	,000	1,427	2,561
	2	1	-8,0304*	,2204	,000	-8,559	-7,502
		3	-6,0364*	,2609	,000	-6,662	-5,411
	3	1	-1,9940*	,2368	,000	-2,561	-1,427
		2	6,0364*	,2609	,000	5,411	6,662

*. The mean difference is significant at the .05 level.

CHAPTER FOUR
CONCLUSIONS

4.1 Conclusion

In this study, three waste water treatment plants influent and effluent data are analyzed and compared. Pollution concentrations are analyzed such as COD (mg/l), BOD(mg/l), SS(mg/l), TP(mg/l), TN(mg/l), NH_4-N(mg/l) furthermore pollution loads which are QCOD (kg/day), QBOD(kg/day), QTP(kg/day) and QTN(kg/day) are also analyzed and compared. Thus the relations and effects of loads on treatment efficiency with each other are searched. All statistical analysis have been carried out by using, influent and effluent data of IMWWTP, GWWTP, and FWWTP.

Raw data are analysed by SPSS 13 (Statistical Package for Social Sciences Programme) and displayed by graphics in Chapter 3. At the first step, descriptive analyses are prepeared, frequency and histogram graphics of raw data are drawn to see the type of distribution. Then the homogenity analysis and graphics are prepeared. Raw data are grouped by homogenity analysis and displayed by the distribution of these groups on graphic, and extreme data groups are seen. Following to this study, the correlation analysis are applied. With these analysis, the association coefficients are calculated. Before regression analysis, scatter graphics are prepared so to see the lineer association between two variables. After than, regression analysis and boxplot graphics are prepeared boxplot graphics also gave some extreme values on each variable. . Generally, most of data of waste water treatment plants have normal distribution.

Table 4.1 Comparison of WWTP's influent value with typical waste water concentration (Metcalf & Eddy, 1991)

	Typical waste water concentration (medium) mg/l	IMWWTP mg/l	GWWTP mg/l	FWWTP mg/l
BOD	200	210±2.87	129±3.96	234±10.09
COD	500	415±4.58	222±4.24	685±21.28
SS	200	217±2.80	155±3.73	762±25.46
TP	8	8±0.07	2.50±0.093	10.96±0.1
TN	40	37±0.33	9.61±0.11	48±0.78

The skewed values are observed on histogram graphics and some extreme values are also observed on box plot and homogeneity graphics. But when the abundance of data are considered and because of the amount in excess of homogen values, the extreme values were not removed from data. Variance analysis (ANOVA) is used to see that whether there is any difference or not between mean of variable such as COD (mg/l), BOD5 (mg/l), SS (mg/l), TP (mg/l), TN (mg/l) and to show the differences and significance of WWTP's influent and effluent data. With variance analysis, the all influent and effluent variables of treatment plants are found statistically significant ($p < 0.05$). It means that mean values are different from each other. But effluent SS values of IMWWTP and GWWTP are not found significant because of their effluent values are almost same.. If we check Table 4.2 , SS effluent value of IMWWTP is 24.81, on Table 4.3, SS effluent value of GWWTP is found 24.58. This result is same with variance analysis result. In this case we can comment that, IMWWTP and GWWTP' SS treatment process efficieny is same.

According to Table 4.1, mean BOD, SS of IWWTP and FWWTP's are higher than typical waste water concentration. Also COD of FWWTP is higher than typical waste water concentration.

1247 number of values of each variable is used for statistic analysis of IMWWTP. When the efficiency of treatment is inspected, effluent data are found equal or under the limit value acording to Table 4.2.

Table 4.2 Discharge values of IMWWTP according to design and process

	Influent design criteria (mg/l)	Design criteria (mg/l)	Influent value (mg/l)*	Effluent value (mg/l)*	Efficiency %
BOD	400	20	210±2.87	22.84±0.71	89
COD	600	100	415±4.58	55.34±0.87	87
SS	500	30	217±2.80	24.81±0.48	88
NH_4N	----	10	23.52±0.28	2.78±0.09	88
TP	6	5	8±0.07	4.5±0.06	43
TN	60	12	37±0.33	10.63±0.16	71

*Values are taken mean value which is descriptive table

In Table 4.2, we can compare design criteria and discharge criteria. According to Table 4.2 effluent value of BOD is 22.84 mg/l, which is over design criteria and its treatment efficieny is 89 %; effluent value of COD is 55.34 mg/l, which is under design criteria and it's treatment efficiency is 87 %; effluent value of SS is 24.81 mg/l, which is under design criteria and it's treatment efficiency is 88 %; effluent value of NH_4N is 2.78 mg/l, which is under design criteria and it's treatment efficiency is 88 %; effluent value of TN is 10.63 mg/l, which is under design criteria and it's treatment efficiency is 71 %.

1035 number of values of each variable is used for statistic analysis of GWWTP. When the COD,BOD,SS and TN data are evaluated, effluent data are found under limit value or same acording to Table 4.3

Table 4.3 Discharge values of GWWTP according to design and process

	Influent design Criteria (mg/l)	Design criteria (mg/l)	Influent value (mg/l)*	Effluent value (mg/l)*	Efficiency %
BOD	400	20	129±3.96	11.07±0.33	91
COD	600	100	222±4.24	52.42±0.87	76
SS	500	30	155±3.73	24.58±0.63	84
TP	11	5	2.5±0.093	0.97±0.03	61
TN	60	12	9.61±0.11	2.6±0.12	73

*Values are taken mean value which is descriptive table

In table 4. 3, we can compare design criteria and discharge criteria. According to table 4.3 effluent value of BOD 11.07 mg/l, which is under design criteria and it's treatment efficieny is 91 %, for COD effluent value is 52.42 mg/l, which is under design criteria and it's treatment efficiency is 76 %. Effluent value of SS is 24.58 mg/l, which is under design criteria and it's treatment efficiency is 84 %. Effluent value of TN is 2.6 mg/l, which is under design criteria and it's treatment efficiency is 73 %

627 numbers of values of each variable are used for statistic analysis for each variable of FWWTP.When the COD, BOD, SS and TN values are evaluated, effluent data are under limit value or same acording to Table 4.4

Table 4.4 Discharge values of Foca WWTP according to design and process

	Influent Design criteria (mg/l)	Design criteria (mg/l)	Influent value (mg/l)*	Effluent value (mg/l)*	Efficiency %
BOD	350	20	234±10.09	5.9±0.2	97
COD	700	100	685±21.28	27.11±0.6	96
SS	500	30	762±25.46	9.2±0.14	98
TP	11	5	10.96±0.19	2.02±0.13	80
TN TKN NH4-N	--- (TKN=60)	12	48±0.78	8.63±0.15	95

*Values are taken mean value which is descriptive table

In table 4.4, we can compare design criteria and discharge criteria. According to table 4.4 effluent value of BOD is 5.9 mg/l, which is under design criteria and it's treatment efficieny is 97 %, effluent value of COD is 27.11 mg/l, which is under design criteria and it's treatment efficiency is 96 %. Effluent value of SS is 9.2 mg/l, which is under design criteria and it's treatment efficiency is 98 %. effluent value of TN is 2.02 mg/l, which is under design criteria and it's treatment efficiency is 95 %. In spite of influent values of FWWTP are higher than IMWWTP and GWWTP, treatment efficiency is rather effective.

In conclusion, COD-SS, COD-TP, COD-TN association are observed result of evaluation for whole WWTP's data. The linear association is found between data by scatter graphics and correlation analysis supported these results. One of the purposes of this study was to compare influent and effluent values of waste water treatment plants. For this reason, the models are established and these models are are tried to prove by regression and correlation analysis. Result of correlation analysis, COD-

BOD (0.283), $p<0.05$, COD-TN (0.238), $p<0.05$, COD-TP (0.427), $p<0.05$, BOD-TP (0.354) , $p<0.05$, SS-TP (0.305), $p<0.05$, TP-TN (0.473), $p<0.05$, COD-SS (0.468) $p<0.05$, relationship are found for IMWWTP's influent and also COD-CONDUCTIVITY, $p<0.05$, COD-SALINITY, $p<0.05$, BOD-TN, $p<0.05$, BOD-NH4-N $p<0.05$, relationship are found for IMWWTP's effluent. But these results were not exact result. Because of this, regression analysis are done, and COD-BOD, COD-TN, COD-CONDUCTIVITY, COD-NH4-N, COD-SALINITY linear relationship are found for IMWWTP's influent and COD-BOD, COD-TP, COD-TN, COD-NH4-N, COD-CONDUCTIVITY relations are found.

For GWWTP's influent COD-TP (0.71), $p<0.05$ is found, for GWWTP's effluent COD-TN (0.25), $p<0.05$ relationship is found by regression analysis. COD-TN (0.779), $p<0.05$ relationship is found for FWWTP's influent and COD-TP relationship is found for FWWTP's effluent.

All this results and the models showed that during the design of waste water treatment plants which are biologic process, design criteria is very much important. In this case, we can comment that there is a positive relationship between COD-BOD_5, COD-TP, COD-TN. This means that when the COD treatment efficiency increase BOD_5, TP, TN treatment efficienciencies will be also increase. Similar result is found on literature searching. According to Choe et al. they found similar results for correlation between COD-SS in their study (Choe, & Bang , & Lee, 2002). Ghararah, & Randall (1991) studied the effect of influent organic compounds on the performance of UCT process. They concluded that at least 20 mg acetic acid as COD is required to remove 1 mg of phosphorus. Also Shrestha, S.et al.(2005) observed strongest correlation between the loadings of SS-COD and COD-TP (Shrestha, & Kazama, & Sakamoto, & Bastola, 2005).

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