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PHYSICO – CHEMICAL STUDY AND BUDGETING OF WASTEWATER FROM HYDERABAD AND LATIFABAD AREA.

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Abstract

During the study period (1999 – 2001) thirty parameters were analyzed and an average of six determinations were examined. Transparency was in the range of 4.42 to 13.42 cm, dissolved oxygen was absent at all sampling stations, biological oxygen demand (BOD) 177 to 367 mg/L, chemical oxygen demand (COD) 312 to 648 mg/L, total nitrogen 12.8 to 33.94 mg/L and total phosphate 2.6 to 7.19 mg/L. Inorganic pollutants: chloride, total residues, total filterable residues and total non – filterable residues were calculated. The average metal ions sodium, calcium, magnesium and potassium were observed in the range of 98.7 to 314 mg/L, 59 to 148 mg/L, 30 to 81.6 and 23.4 to 56.8 mg/L respectively. SAR values were calculated in the range of 2.47 to 5.3. The total quantities of wastewater discharge from Hyderabad city areas were calculated to be 103235 m^3/day. The results indicate 26.949 ton/day (t/d) of chloride, 0.467 t/d of total hydrolysable phosphate, 2.433 t/d of Kjeldahl nitrogen, 152.024 t/d of total residues, 144.988 t/d of total filterable residues, 36.105 t/d of non – filterable residues, 17.302 t/d of sodium, 8.511 t/d of calcium, 4.917 t/d of magnesium and 3.466 t/d of potassium.

Keywords: Wastewater, physico-chemical study.

Introduction

Hyderabad, the second largest and populous city of Sindh, is situated about 160 km east of Karachi. The population of Hyderabad city according to PC – I of HDA is about 1.6 million (HDA, PC – 1., 2000). This city like other cities of Pakistan is also facing an acute problem towards safe disposal of its wastewater at proper places The wastewater from Hyderabad city areas is disposed off either by gravity flow or by means of pumping into Phuleli or Pinyari canal without any treatment (Laghari, 2001). The present work examines the wastewater quality of Hyderabad city areas before ending into irrigation canals.

Materials and Methods

Nine samples of wastewater were collected from open sewers and disposal stations throughout the city areas. The samples were collected during Nov. 1999 to May 2000 at an interval of 4 to 5 weeks in clean pre – washed 1.5 L plastic bottles after rinsing several times with sampled water. The samples from wastewater disposal stations were collected at the time, when pumps were actually functioning. The samples from open sewers were collected with the help of 1 L bucket. The time of collection of samples was noted and temperature of air 1m above surface of wastewater was measured with mercury thermometer. Transparency was measured with Secchi disc.

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The samples were transferred to the laboratory as soon as possible after collection and analyzed for physico-chemical parameters.

Salinity, conductivity and total dissolved solids (TDS) were determined with WTW LF 320-conductivity bridge. Alkalinity, chloride and hardness were determined by titrimetry by using standard hydrochloric acid (0.01N), silver nitrate (0.01N) and EDTA (0.01M) solution respectively. Dissolved oxygen (DO) was evaluated by Wrinkler method. Kjeldahl nitrogen (KN) and ammonia nitrogen were determined by using standard procedures [Broadbent, 1985., Al – Dhowalia, 1984., APHA, 1976]. Organic nitrogen was calculated by subtracting ammonia nitrogen from total Kjeldahl nitrogen. Orthophosphate was determined by reducing phosphomolybdic acid formed with ascorbic acid to molybdenum blue. Total phosphate was estimated by persulphate acid hydrolysis, followed by determination as for orthophosphate. Total residues were estimated by evaporating a well - mixed sample (50 mL) gently in pre weighted dry beaker at 80 to 90 °C and dried at 105 ± 5 °C for two hours. The increase in weight of beaker indicate total residues. The filterable and non-filterable residues were calculated by filtering well-mixed sample (50 mL) through pre weighted glass fiber paper filter of Ø 47mm diameter. The filtrate was evaporated and dried at 105 ± 5 °C. The increase in weight of filter paper showed non-filterable residues. Condensed phosphate was calculated by subtracting orthophosphate from total phosphate phosphorus. Sodium, calcium, magnesium and potassium were determined by air-acetylene atomic absorption using Varian AA-20 atomic absorption spectrometer at the conditions recommended by the manufacturer. Sodium, potassium, calcium and magnesium were determined at 589, 766.5, 422.7 and 285.2 nm respectively in the triplicate; with delay time 3 sec and integration time 3 sec. Proteins were obtained by multiplying ammonia nitrogen with 6.25 and sodium absorption ratio (SAR) value were calculated by using following equation.

$$SAR = \frac{Na}{\sqrt{\frac{Ca + Mg}{2}}}$$

The sewage and water discharge entering into irrigation canals by gravity flow were calculated by using standard methods (Khurmi, 1978). The parameters were noted from individual sites. The quantity of wastewater from disposal stations was calculated from the rain emergency plan (WASA, 1999). All the necessary help was obtained from the office of the Water and Sanitation Agency (WASA) of Hyderabad Development Authority (HDA).

Results and Discussions

Wastewater can be divided into domestic and industrial wastewater and depends upon the population density, the industrial practices and the habits of the local population. Wastewater carries disease-causing pathogens and potential toxic elements. Unmanaged disposal of wastewater may lead to the contamination of the groundwater aquifers.

The average temperature (n = 6) of air and wastewater was observed in the range of 27.5 to 32.5 ^{O}C and 24.2 to 26 ^{O}C respectively. Transparency (Table 2) was observed in the range of 4.42 to 13.42 cm with highest value of 13.42 cm at sampling station No. 7. Conductivity, pH, salinity and TDS of wastewater were observed in the range of 1.26 – 2.65 mS/cm, 6.89 – 7.23, 433.3 – 1283 mg/L and 807 – 1768.5 mg/L respectively. The highest and lowest value of conductivity 2.65 and 1.26 mS/cm were observed at sampling stations No. 7 and 6 respectively (Table 2). The NEQ's guideline values for conductivity and pH are 3.1 mS/cm and 6.5 – 8.5 for wastewater; therefore the observed values remain within the limits. Alkalinity, chloride and hardness were observed in the range of 301 to 444 mg/L, 166.2 to 396 mg/L and 215.5 to 487 mg/L respectively and were within the NEQ's limits (Table 3). Dissolved oxygen was found absent, biological oxygen demand (BOD_5) and chemical oxygen demand (COD) were observed in the range of 177 to 367 mg/L and 312 to 648 mg/L respectively (Table 3). Lowest values of BOD_5 and COD of 177 mg/L and 312 mg/L were observed from samples collected at sewage ponds (Sample No. 7). The values are higher than NEQ's guideline values for BOD_5 and COD (Table 4).

The average observed values of total residues, total filterable residues and total non – filterable residues were observed in the range of 1106 – 2165 mg/L, 790 – 1732 mg/L and 296 – 446 mg/L respectively (Table 4). NEQ's guideline values for suspended solids are 150mg/L; therefore the observed results were higher than permissible safe limits. The average values of total phosphate, orthophosphate and condensed phosphate were observed in the range of 2.6 – 7.19 mg/L, 2.105 – 6.29 mg/L and 0.5 – 0.9 mg/L respectively (Table 4).

The average values of Kjeldahl nitrogen, ammonia nitrogen and organic nitrogen was observed in the range of 12.8 – 33.94 mg/L, 6.71 – 22.72 mg/L and 3.94 – 17.23 mg/L respectively and the nitrite nitrogen was observed in the range 0.06 – 0.095 mg/L. Proteins were calculated from the results of ammonia nitrogen by multiplying with 6.25 (APHA, 1976) and the average results were observed in the range of 42 – 142 mg/L (Table 5).

The average values of Na, Ca, Mg and K were observed in the ranges of 98.7 – 313.5 mg/L, 59 – 148 mg/L, 30 – 81.6 mg/L and 23.4 – 56.8 mg/L respectively (Table 6). The study of major cations (Na, Ca, Mg and K) revealed that sodium was dominant cation and potassium contributed the lowest concentration in wastewater. The major captions showed the following decreasing pattern of concentration.

$$Na > Ca > Mg > K$$

The average SAR value of wastewater was observed in the range of 2.47 – 5.3 (Table 6). The total water supply by WASA of HDA to Hyderabad city is 1.74×10^5 m^3/d (46 MGD) from six treatment plants (Table 7). It is assumed that 20 % overall losses could occur in the distribution and collection system, thus 1.41×10^5 m^3/d (36.8 MGD) could be collected. Among these 74 % (103235 m^3/day) of total wastewater was disposed into irrigation canals and only 25 % (36067 m^3/day) of wastewater goes to agricultural fields, open fields and SSTP. The details of wastewater contribution at different sampling stations and the total load of different chemical parameters of wastewater were calculated with the help of chemical analysis. The results are summarized in tables 9 & 10.

The percentage contribution of wastewater at various sampling stations of Hyderabad city area is as under. Sampling stations 1, 2, 3, 4, 5, 6, 7, 8 and 9 contributed as 25, 15, 16, 3, 12, 3, 17, 1 and 8 % respectively (Table 8).

The loads of chloride, total hydrolysable phosphate, total Kjeldahl nitrogen, total residues, filterable residues, non – filterable residues, sodium, calcium, magnesium and potassium were calculated on average flow basis (Tables 9 and 10).

Total load from all sampling stations were calculated as, chloride 26.949 t/d, total hydrolysable phosphate 0.467 t/d, total Kjeldahl nitrogen 2.433 t/d, total residues 152.024 t/d, total filterable residues 114.988 t/d, total non–filterable residues 36.105 t/d, sodium 17.302 t/d, calcium 8.511 t/d, magnesium 4.917 t/d and 3.466 t/d of potassium.

The study of metal ions Na, Ca, Mg and K again shows that sodium was dominant cation and potassium contributed the lowest concentration in wastewater.

Conclusion

During the study period, the sewage was observed highly loaded with BOD, COD and residues. Their addition into Phuleli or Pinyari canals without treatment is not recommended.

Suggestions

1. It was observed that northern sewage treatment plant is constructed since long for the treatment of city wastewater, therefore it is recommended that wastewater from all these areas should be diverted without loosing any time.

2. The wastewater showed high COD at sampling stations 4, 5, 6 and 9 and may be aerated before discharging into canal.

3. The use of wastewater without treatment and proper dilution can create serious problems for the soil as well as for workers. Its use for vegetable crops, which are eaten raw or uncooked, should be avoided.

4. It is recommended that the wastewater can be used after primary treatment and appropriate dilution for the cultivation of the crops, bearing fruits above the surface for example wheat, oil seed etc.

5. Treated and diluted wastewater could preferably be used for the crops such as cotton, which do not involve human consumption. But during picking of the cotton, special care should be taken.

6. The SAR values of wastewater are on the margin of the safe use for irrigation; therefore care is needed in their use for long time.

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Table: 1. Sampling stations of old Hyderabad city area disposing wastewater into phuleli and pinyari canals

S No.	Station/site	Remarks
1	Makrani Para (Disposal station)	Disposes wastewater in agriculture fields near General bus stand and to Drya Khan disposal station.
2	Drya Khan (Disposal station)	Disposes untreated wastewater into Phuleli canal.
3	Effendi town near old powerhouse. (Disposal station)	Disposes untreated wastewater into Phuleli canal.
4	Rashi Ghat disposal. (Open drain)	Disposes untreated wastewater into Phuleli canal by gravity flow.
5	Liaquat Ashraf colony. (Open drain)	Disposes untreated wastewater into Phuleli canal by gravity flow.
6	Kari mori. (Open drain)	Disposes untreated wastewater into Phuleli canal by gravity flow.
7	Jacob tank (Disposal station)	Disposes untreated wastewater into Phuleli canal.
8	Bhatti village (Tando Thorho) (Disposal station)	Disposes untreated wastewater into Phuleli canal.
9	Pretabad (Disposal station)	Disposes untreated wastewater into Pinyari canal.

S. No. stands for sampling stations.

Table: 2. Physico – chemical analysis of wastewater collected from different sampling stations of Hyderabad City area disposing off into phuleli and pinyari canals, (n = 6), mean ± sd, range.

Sample No.	Air temp.^{O}C	W. W. temp. ^{O}C	Sacchi depth. (cm)	Conductivity mS/cm	pH	Salinity Mg/L	TDS mg/L
1	31.7 ± 5 (27 – 40)	25 ± 3.4 (21 – 30)	9.42 ± 4.4 (4.5 – 16)	1.275 ± 0.14 (1.14 – 1.5)	7.07 ± 0.07 (6.98 – 7.14)	433.3 ± 103.3 (300 – 600)	814.7 ± 89.6 (727 – 952)
2	32 ± 5.4 (27 – 36)	24.2±4.75 (19 – 30)	8.42 ± 2.4 (5.5 – 12)	1.9 ± 0.31 (1.61 – 2.31)	7.07 ± 0.05 (6.99 – 7.14)	783.3 ± 98.3 (700 – 900)	1214.2 ± 200 (1034 – 1478)
3	32.5 ± 6.3 (25 – 41)	24.8 ± 4.7 (19 – 30)	5.08 ± 0.38 (4.5 – 5.5)	1.57 ± 0.15 (1.45 – 1.74)	6.96 ± 0.2 (6.78 – 7.07)	600 ± 109.5 (500 – 700)	1002.5 ± 96 (886 – 1114)
4	32.2 ± 7.1 (25 – 42)	25.2 ± 4.3 (20 – 30)	4.42 ± 0.8 (3 – 5)	1.56 ± 0.37 (1.25 – 2.22)	6.89 ± 0.13 (6.75 – 7.06)	616.7 ± 248 (400 – 1100)	996 ± 237.6 (772 – 1420)
5	32.5 ± 7.6 (25 – 42)	26 ± 4.3 (21 – 31)	4.5 ± 0.44 (4 – 5)	1.47 ± 0.18 (1.16 – 1.69)	6.97 ± 0.13 (6.77 – 7.1)	550 ± 137.8 (300 – 700)	928 ± 119.2 (742 – 1085)
6	32.3 ± 7.8 (24 – 42)	25.5 ± 4.1 (21 – 31)	4.67 ± 0.6 (4 – 5.5)	1.26 ± 0.18 (1.03 – 1.48)	6.91 ± 0.2 (6.66 – 7.15)	450 ± 105 (300 – 600)	807 ± 116.1 (662 – 948)
7	31.83±7.3 (25 – 42)	25.7 ± 5.9 (19 – 34)	13.42 ± 3 (9 – 17.5)	2.65 ± 0.35 (2.27 – 3.26)	7.23 ± 0.08 (7.1 – 7.33)	1283.3 ± 194 (1100–1600)	1768.5±203.6 (1600 – 2086)
8	31.5 ± 6.3 (25 – 41)	24.5 ± 4.2 (19 – 30)	7.33 ± 2.13 (5 – 11)	1.4 ± 0.3 (1.02 – 1.73)	7 ± 0.12 (6.81 – 7.18)	483.3 ± 98.3 (300 – 600)	892 ± 193 (653 – 1110)
9	31 ± 7.2 (25 – 41)	24.5 ± 3.9 (20 – 29)	4.5 ± 1.14 (3 – 6)	2.14 ± 0.5 (1.25 – 2.62)	6.99 ± 0.2 (6.8 – 7.35)	917 ± 231.7 (500 – 1200)	1370 ± 316.6 (801 – 1677)

Table: 3. Physico – chemical analysis of wastewater collected from different sampling stations of Hyderabad city area disposing off into phuleli and pinyari canals, (n = 6), mean ± sd, range.

Sample No.	Alkalinity as $CaCO_3$, mg/L	Chloride, mg/L	Hardness as $CaCO_3$, mg/L	Dissolved oxygen, mg/L	BOD mg/L	COD mg/L
1	300.8±114.3 (190 – 415)	166.2±29.4 (129.4 – 212)	243.3±83.6 (150 – 340)	ND	201±82 (57 – 279)	345±158 (99.84 – 493)
2	356 ±128 (220 – 495)	307.25±58 (248 – 390)	303±104 (210 – 420)	ND	265±114 (124 – 417)	468±221 (219 – 736)
3	395±170 (200 – 600)	189±58 (106 – 248)	282.2±117 (170 – 460)	ND	246±111 (127 – 419)	434.3±214.3 (224 – 740)
4	371±152.4 (205 – 555)	218.55±140.6 (106.3 – 496)	218±81 (140 – 300)	ND	367±82.6 (198 – 436)	648±160 (349.4 – 800)
5	382±163 (230 – 595)	201±29 (177 – 248)	232.2±90 (143 – 340)	ND	335±80 (235 – 435)	592±155 (416 – 768)
6	337.5±142 (200 – 542)	171.3±27 (142 – 213)	215.5±78 (150 – 310)	ND	295±97 (199 – 435)	520.5±187 (352 – 768)
7	314.3±125 (200 – 542)	396±76 (319 – 532)	487±228 (140 – 760)	ND	177±58.6 (99 – 256)	312±113.5 (175 – 453)
8	365±165 (195 – 570)	177.3±32 (142 – 213)	224.2±84 (140 – 330)	ND	210±76 (71 – 300)	371.5±147 (125 – 512)
9	444.2±199 (200 – 675)	354.5±95 (213 – 496)	303±110 (170 – 440)	ND	311±46 (290 – 372)	549.2±89.3 (416 – 658)

Table: 4. Chemical analysis of wastewater collected from different sampling stations of Hyderabad city area disposing off into phuleli and pinyari canals, (n = 6) mean ± sd, range.

Sample No	Total residues, mg/L	Total filterable residues, mg/L	Total non – filterable residues, mg/L	Total hydrolysable phosphate, mg/L	Ortho phosphate, mg/L	Condensed phosphate, mg/L
1	1105.7±154 (960 – 1367)	808±89.5 (717 – 942)	298±92 (196 – 471)	4.53±2.2 (3.15 –8.875)	3.2±0.55 (2.4 – 3.9)	0.5±0.3 (0.19 – 1.1)
2	1536±211 (1263 – 1796)	1189±189 (1017 – 1440)	346±56.3 (246 – 398)	3.79±0.98 (2 – 4.63)	3.1±0.71 (1.95 – 4.02)	0.56±0.4 (0.05 – 1.12)
3	1378±68.5 (1300 – 1450)	986.2±92 (874 – 1087)	392.2±96 (228 – 503)	5.22±0.8 (4.55 – 6.32)	4.45±0.8 (3.4 – 5.5)	0.8±0.3 (0.43 – 1.15)
4	1309.2±247.4 (1173 – 1805)	982±234 (748 – 1398)	327.5±91.4 (206 – 433)	5.47±0.76 (4 – 6.04)	4.75±0.5 (3.85 – 5.85)	0.72±0.4 (0.15 – 1.24)
5	1211±106 (1039 – 1366)	915±100 (734 – 1019)	296.2±51 (235 – 360)	5.41±1.7 (2.75 –7.75)	4.62±1.4 (2.5 – 6.2)	0.8±0.5 (0.25 – 1.55)
6	1159±95 (1044 – 1275)	790.2±103 (659 – 929)	369±51 (316 – 450)	4.33±0.34 (3.96 – 4.91)	3.53±0.5 (2.8 – 4.1)	0.79±0.5 (0.18 – 1.54)
7	2165±228 (1860 – 2525)	1732±203 (1574 – 2052)	383.2±138 (145 – 540)	2.6±0.7 (1.25 – 3.21)	2.10±0.65 (1 – 2.71)	0.51±0.35 (0.23 – 1.15)
8	1220±240 (851 – 1478)	876±191 (642 – 1103)	345±92.4 (160 – 410)	5.31±0.84 (4.12 – 6.12)	4.24±1.4 (2.6 – 6)	0.74±0.4 (0.12 – 1.15)
9	1787±344.5 (1148 – 2057)	1340±309 (786 – 1624)	446±51 (362 – 500)	7.19±1.02 (5.55 – 8.44)	6.29±1.04 (4.75 –7.69)	0.9±0.4 (0.3 – 1.43)

Table: 5. Physico–chemical analysis of wastewater collected from different sampling stations of Hyderabad city area disposing off into phuleli and pinyari canals, (n = 6), mean ± sd, range.

Sample No.	Kjeldahl nitrogen, mg/L	Ammonia nitrogen, mg/L	Organic nitrogen, mg/L	Nitrite nitrogen, mg/L	Proteins, mg/L
1	20.16±10.3 (5.6 – 30.38)	16.2±8.4 (4.2 – 26.6)	3.94±2.8 (1.4 – 7.7)	0.062±0.01 (0.05 – 0.08)	102.1±52 (26.25 – 166.2)
2	21.5±9.9 (10.6 – 30.94)	13.31±7.35 (5.04 – 20.8)	8.17±2.9 (4.52 – 11.48)	0.07±0.02 (0.055 – 0.1)	83.2±46 (31.5 – 130)
3	32.3±16.55 (14.14 – 49)	18.41±10.75 (8.04 – 31.78)	13.9±7.1 (6.1 – 23.32)	0.095±0.05 (0.059 – 0.17)	115±67.1 (50.25 – 198.6)
4	33.42±14.71 (17.84 – 50.62)	16.35±8 (6.72 – 26.04)	17.23±8.55 (10.3 – 32.14)	0.06±0.03 (0.07 – 0.129)	102±50 (42 – 162.75)
5	28.23±12.6 (14.48 – 42.42)	16.3±9.9 (4 – 26.12)	11.93±3.92 (6.96 – 18.9)	0.09±0.046 (0.06 – 0.158)	102±62 (25 – 163.25)
6	22.53±7.6 (14.14 – 30.8)	11.64±6.6 (4.76 – 22.8)	10.9±3.4 (6.8 – 16.1)	0.08±0.036 (0.05 – 0.132)	73±41 (29.75 – 142.5)
7	12.8±5.3 (6.02 – 18.2)	6.71±4.6 (1.2 – 12.6)	6.1±2 (2.38 – 7.6)	0.065±0.045 (0 – 0.1)	42±29 (7.5 – 78.75)
8	28.51±13 (17.1 – 51.72)	13.16±6.15 (7 – 23.1)	15.35±7.25 (9.7 – 28.62)	0.07±0.022 (0.05 – 0.1)	82.3±38.5 (43.75 – 144.4)
9	33.94±16.1 (12.88 – 51.66)	22.72±12.3 (7.32 – 35.84)	11.23±4 (5.56 – 15.82)	0.085±0.03 (0.05 – 0.12)	142±77 (45.75 – 224)

Table: 6. Physico-chemical analysis of wastewater collected from different sampling stations of Hyderabad city area disposing off into phuleli and pinyari canals, (n = 6), mean value ± standard deviation, (min. – max.)

Sample No.	Sodium mg/L	Calcium mg/L	Magnesium (Mg), mg/L	Potassium (K), mg/L	SAR
1	98.7±13 (88.65 – 124.58)	64.3±8.3 (55.4 – 75.6)	37.8±22.8 (26.5 – 84)	23.44±7.6 (16.25 – 37)	2.47±0.5 (1.76 – 3.19)
2	190.25±44.8 (157.8 – 277)	71.95±4.5 (67.2 – 79)	53.7±33 (35.2 – 121)	31.16±9.45 (24 – 49)	4.27±1.2 (2.85 – 6.42)
3	116±24.6 (75.35 – 136)	78±17.4 (60.55 – 109)	38.56±26 (24.85 – 91)	36.8±9.9 (26.75 – 51)	2.75±0.6 (2.056 – 3.51)
4	135±59 (80.05 – 249)	59±12 (49.1 – 82.1)	32±17.8 (22.45 – 68)	38.41±7.8 (31.05 – 49)	3.6±1.6 (2.1 – 6.655)
5	134.6±36 (95.65 – 194)	65.3±10.6 (50.5 – 81.9)	35.8±18.4 (24.4 – 72)	41.3±6.2 (34.2 – 50)	3±1 (1.78 – 4.45)
6	108±18.4 (84 – 127)	64.2±6.4 (59 – 74.45)	30±15.8 (21 – 62)	32±8.47 (23.9 – 47)	2.84±0.6 (1.82 – 3.42)
7	313.5±69 (235 – 424)	148±24.7 (113.4 – 182)	81.6±41.5 (50 – 164)	31.4±9.9 (23.9 – 49)	5.3±1.7 (3.18 – 8.05)
8	106.6±21 (74.5 – 127)	62.3±20.5 (48.2 – 101)	39±31 (22.05 – 103)	36±10.9 (23.4 – 56)	2.8±0.8 (1.724 – 3.55)
9	219.05±79 (116 – 342)	67.1±14 (56.05 – 91.9)	43.3±27 (21.6 – 97)	56.77±19.6 (37 – 92)	5.175±1.6 (3.25 – 7.52)

Table: 7. Quantity of water supply to Hyderabad from different treatment plants

S No	Site	Water supply MGD	Water supply million liters per day	Water supply m^3/day	% Contribution
1	New Treatment Plant at Jamshoro Road	30	113.562	113562	67
2	Old Treatment Plant at Jamshoro Road	10	38	37854	23
3	Hala Road Treatment Plant	2	7.6	7570	3
4	Preetabad Treatment Plant	2	7.6	7571	3
5	Pontoon Bund Treatment Plant	1	4	3785	2
6	Onetree Bund Treatment Plant	1	4	3785	2
Total		46	174	174128	100

Data was obtained from WASA of HDA, Qasimabad office.

Table: 8. Contribution of wastewater from Hyderabad city to phuleli canal and pinyari canal

S. No	Sampling station	Quantity of wastewater (million liters per day)	Quantity of wastewater (m^3 / day)	% Contribution	Disposing area
1	Mir Khan colony disposal station	26.573	26573	25	Agriculture fields
2	Darya Khan Panhwar disposal station	14.973	14973	15	Phuleli canal
3	Old power house + Effendi town	16.421	16421	16	Phuleli canal
4	Rashi Ghat Open Nala	2.794	2794	3	Phuleli canal
5	Liaquat Ashraf colony Open Nala.	11.879	11879	12	Phuleli canal
6	Kari mori Open Nala	2.794	2794	3	Phuleli canal
7	Hur camp disposal station	18.170	18170	17	Phuleli canal
8	Bhatti village disposal station.	1.453	1453	1	Phuleli canal
9	Preetabad disposal station.	8.176	8176	8	Pinyari canal
Total		103.235	103235	100	

Table: 9. Total quantities of different parameters in the wastewater collected from Hyderabad city areas.

Sampling stations	Chloride ton / day	Total hydrolysable phosphate, ton / day	Total Kjeldahl nitrogen, ton / day	Total residues, ton / day	Total filterable residues, ton / day	Total non – filterable residues, ton / day
1	4.417	0.120	0.536	29.39	21.471	7.919
2	4.597	0.057	0.322	23	17.803	5.181
3	3.104	0.086	0.530	22.63	16.191	6.437
4	0.611	0.015	0.093	3.657	2.744	0.915
5	3.388	0.064	0.335	14.385	10.870	3.516
6	0.479	0.012	0.063	3.24	2.21	1.030
7	7.195	0.047	0.233	39.338	31.470	6.959
8	0.258	0.007	0.041	1.773	1.273	0.501
9	2.90	0.059	0.28	14.611	10.956	3.647
Total	26.949	0.467	2.433	152.024	114.988	36.105

Table: 10. Total quantities of different parameters in the wastewater collected from Hyderabad city areas.

Sampling stations	Sodium ton / day	Calcium ton / day	Magnesium ton / day	Potassium ton / day
1	2.623	1.709	1.01	0.622
2	2.849	1.078	0.808	0.467
3	1.905	1.281	0.632	0.604
4	0.377	0.165	0.09	0.107
5	1.604	0.772	0.428	0.491
6	0.302	0.179	0.084	0.089
7	5.696	2.689	1.483	0.570
8	0.156	0.090	0.057	0.052
9	1.790	0.548	0.325	0.464
Total	17.302	8.511	4.917	3.466

Table: 11. Wastewater quality standards

S. No.	Parameters with units	National effluent quality standards (NEQ's)	WHO standards
1.	pH	6.5 – 8.5	6.5 – 8.5
2.	BOD_5, mg/L	80	-
2.	COD, mg/L	150	-
3.	TDS, mg/L	2000	-
4.	Temperature, ^{O}C	40	-
5.	Suspended solids, mg/L	150	-
6.	Ammonia, mg/L	40	-
7.	Chloride, mg/L	1000	-
8.	Hardness as $CaCO_3$, mg/L	500	-
9.	Conductivity, mS/cm	3.1	-

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