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# Flow Measurement and Raw Sewage Characteristic Determination in Kashan Textile Factories

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**Abstract:** The Kashan is an industrial city which have many textile factories. At present, Raw industrial sewage used for agriculture in Kashan which can cause environmental pollution and adversely effects human health. In this study for flow measurement a rectangular weir is used. The results shows that the average flow of Kashan Textile Sewage (KTS) were 107.5 cubic meters per hour. Composite samples were obtained from raw sewage (Seven samples at different time during the day) for heavy metal and physicochemical analysis. The average concentration of $BOD_5$, COD, TSS and colour were 109, 583, 169 and 108 mg $L^{-1}$ true colour unit, respectively. The average concentration of heavy metal in raw sewage were less than Iranian reuse standard, except for cobalt. These sewage has the BOD to COD ratio, as far as less than 0.5 that indicates these sewage is not biotreatable and for treatment require chemical process.

**Key words:** Textile sewage, pollution, human health, composite, heavy metal

## INTRODUCTION

The Kashan is one of the industrial city in Iran especially in the field of textile factories. This factories established many decade ago. The three major textile factories in Kashan is including Risandegi and Bafandegi number one, two and three-Harir and Makhmal and Kork. The products of above mentioned factories include a variety of textile, Makhamal and Mechanical carpets. This factories is located as disperse at boundary of Kashan city.

The water consumption at textile factories divided into two categories including sanitary purposes and industrial uses that in Kashan Textile Factories (KTF), water for sanitary proposes is supplied by Kashan drinking water network and for industrial uses by deepwater well. The sanitary sewage without treatment discharge to absorption well and industrial sewage were collected by sewer and finally, flowing to a channel which known as " black water channel " that located in proximity of Nooshabad road and terminated to Kashan desert. The sources of industrial sewage at KAF is including to various unit such as dyeing, printing, finishing, processing, Air conditioning, water softening plant, cooling water, bleaching and washing.

These sewage mixed together at each factories and no separation is carried out inplant. Because of economical problems until today no attempts is carried out for treatment of Kashan Textile Sewage (KTS). At several past decade, the raw industrial sewage widely used for agriculture, such conditions has adverse effects on the environment and public health status in Kashan region and finally, resulting to pollution the soil, water and agricultural products.

The textile industrial sewage generally contains synthetic chemicals, dyes, suspended solid and heavy metals, thus, cause environmental problem if no treatment are taken. Based on the standards law and related ordinances, whole factories must construct and maintain their own treatment facilities[1].

The purpose of this study was to evaluate the flow and characteristic of raw sewage generated in KTF.

## MATERIALS AND METHODS

The experimental study was conducted during the summer of 2003. For flow measurement a rectangular weir with 0.67 m width was installed on the route of sewage channel. The depth of sewage on the weir were measured daily every two hours during 30 days. The following equation is used to calculate the flow rate[2].

$$Q = 2/3\ C_d\, b\ \ 2g^{1/2}\ \ H^{3/2}$$

Where:

Q = Flow rate as cubic meter per second
$C_d$ = Discharge coefficient, typically 0.61
B = Width of weir (0.67 m)
G = Gravity forces, 9.81 meter per square seconds.
H = Depth of sewage on the weir as meters

Raw sewage samples were 24 h composite samples. A total of seven sample sets were analysed for BOD, COD, TSS, Total Nitrogen (TN), total phosphorus and colours. Five sample for heavy metals such as zinc, lead, mercury, arsenic, cadmium, chromium and cobalt over the period of study.

These samples were collected in a plastic container with 2 L volume.

Biochemical oxygen demand, chemical oxygen demand total suspended solid, total nitrogen, total phosphorus and colour were analysed according to standard methods for examination of water and wastewater and heavy metals was determined by atomic absorption method[3].

## RESULTS AND DISCUSSION

Figure 1 shows hourly average flow of KTS during the 30 days study period. As demonstrated in the table minimum and maximum flow were 32 and 170 $m^3$ $h^{-1}$, respectively. The mean flow was 107.5±36 $m^3$ $h^{-1}$. The results of flow measurement showed that within 30 day period, minimum flow occurred at 2 A.M and maximum at 6 P.M.

Table 1 presents the characteristics of raw mixed sewage of the KTF. The results of studies showed that the average concentration of COD = 583 mg $L^{-1}$, BOD = 109 mg $L^{-1}$, TSS = 169 mg $L^{-1}$, TN = 13 mg $L^{-1}$, TP = 1.1 mg $L^{-1}$ and true colour = 108 TCU (true colour unit). The high mean concentration of COD and colour were associated with presence of synthetic chemicals such as dyes which used at textile factories to dyeing processing and printing.

Table 2 shows the effluent standard of Iran for reuse in agriculture. Based on the results recorded in Table 1 and by comparing with data in Table 2 concluded that the concentration of BOD, COD, TSS and colour is higher the threshold of the IRANIAN Reuse Standard. In this case, the average concentration of BOD is only slightly more than IRANIAN standard. Figure 2 shows ratio between BOD and COD at raw mixed sewage of KTF. The figure shows that BOD/COD were 0.08 to 0.25 with average of 0.17 by comparing these results with domestic sewage (BOD/COD = 0.4-0.8) can be concluded that at textile sewage this ratio are less than the domestic sewage, this is mainly due to presence of synthetic chemicals and dyes at textile sewage.

Table 1: Raw mixed sewage characteristic of Kashan Textile Factories

| No. of sample | BOD (mg $L^{-1}$) | COD (mg $L^{-1}$) | TSS (mg $L^{-1}$) | TN (mg $L^{-1}$) | TP (mg $L^{-1}$) | Colour TCU |
|---|---|---|---|---|---|---|
| 1 | 172 | 900 | 312 | 10.07 | 0.93 | 129 |
| 2 | 36 | 186 | 65 | 6.70 | 0.13 | 93 |
| 3 | 34 | 320 | 74 | 9.06 | 0.80 | 89 |
| 4 | 35 | 408 | 96 | 15.00 | 1.28 | 95 |
| 5 | 91 | 434 | 155 | 16.50 | 1.63 | 99 |
| 6 | 127 | 774 | 152 | 13.20 | 0.80 | 110 |
| 7 | 269 | 1067 | 332 | 20.20 | 2.31 | 143 |
| Mean | 109±88 | 583±330 | 169±110 | 13±4.70 | 1.1±0.7 | 108±20 |

Table 2: Iranian reuse standard for agriculture irrigation

| No. of sample | Parameters | Maximum limits | Number | Parameters | Maximum limits |
|---|---|---|---|---|---|
| 1 | BOD | 100 mg $L^{-1}$ | 8 | AS | 0.1 mg $L^{-1}$ |
| 2 | COD | 200 mg $L^{-1}$ | 9 | Cr | 1 mg $L^{-1}$ |
| 3 | TSS | 100 mg $L^{-1}$ | 10 | Cd | 0.2 mg $L^{-1}$ |
| 4 | TN | Not Recommended | 11 | Hg | Nil |
| 5 | TP | Not recommended | 12 | Pb | 1 mg $L^{-1}$ |
| 6 | Zn | 2 mg $L^{-1}$ | 13 | Color | 75 units as TCU |
| 7 | Co | 0.05 mg $L^{-1}$ | | | |

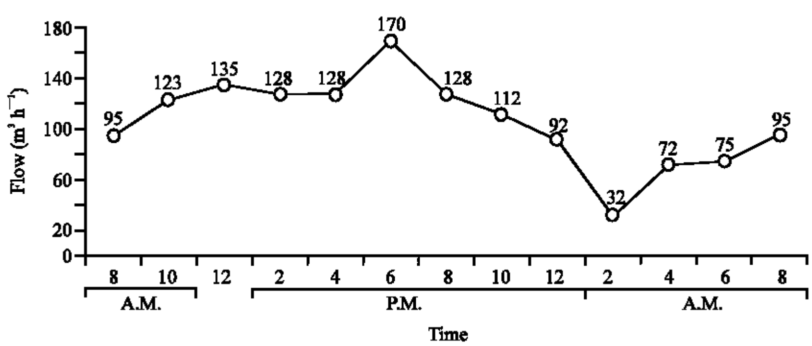


Fig. 1: Variation of sewage flow in Kashan Textile Fractories (KTF)

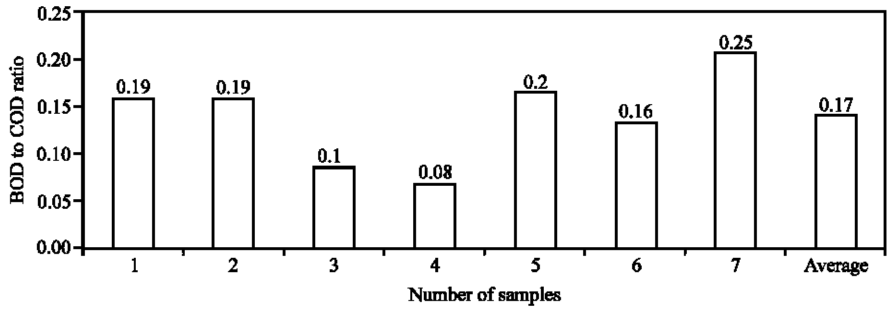


Fig. 2: BOD to COD ratio in Kashan Textile Sewage (KTS)

Table 3: Heavy metal concentration in Kashan textile sewage

| No. of sample | Metals | | | | | | |
|---|---|---|---|---|---|---|---|
| | Cr | CO | Pb | Hg | ZN | AS | Cd |
| 1 | 0.63 | 0.103 | 0.14 | Zero | 0.13 | 0.0004 | 0.03 |
| 2 | 0.65 | 0.06 | 0.16 | Zero | 0.08 | 0.0006 | 0.02 |
| 3 | 1 | 0.03 | 0.08 | Zero | Zero | 0.0007 | 0.07 |
| 4 | 1.2 | 0.06 | 0.15 | Zero | 0.11 | 0.0008 | Zero |
| 5 | 1.04 | 0.05 | 0.11 | Zero | 0.13 | Zero | Zero |
| Mean | 0.9±0.25 | 0.06±0.02 | 0.13±0.03 | Zero | 0.09±0.05 | 0.00052±0.0003 | 0.024±0.02 |

The results of heavy metals concentration in the raw mixed sewage of KTF are shown in Table 3. The table shows that the mean concentration of Cr = 0.9 mg $L^{-1}$, CO = 0.06 mg $L^{-1}$, Pb = 0.13 mg $L^{-1}$, Zn = 0.09 mg $L^{-1}$, AS = 0.00052 mg $L^{-1}$ and Cd = 0.024 mg $L^{-1}$ and mercury is not present in this sewage. It is clear from Table 3 that except for cobalt, with relatively high concentration, all the other heavy metals has mean concentration of less than Iranian Reuse Standard (Table 2).

## CONCLUSIONS

The daily cycle studies showed that flow generation have very variation with time. The Fig. 1 shows also that highest flow generation were between 8 A.M to 12 mid-night that coincided with operation of factories during the business activities[4].

The understanding of sewage flow and fluctuating with time is extremely importants for design of industrial treatment facility and these facilities must be constructed for maximum hourly flow[5,6]. In this case maximum sewage flow were 170 cubic meters per hours.

The results of these studies shows that in the textile sewage presence of non-biodegradable materials is higher than domestic sewage which resulting to lower BOD to COD ratio. Because of BOD to COD ratio in Kashan Textile Sewage is less than 0.5, thus, this sewage is not biologically treatable[4,6,7].

The efficient removal of COD and Colour are important consideration in the selection of a process for treatment of textile sewage. The presence of nitrogen and phosphorus is effective for agricultural reuse[8,9]. Because of low concentration, the removal of heavy metals from Kashan Textile Sewage is not detrimental factor to treatment process selection[10].

Such a process could be implemented at little cost and provide an effect suitable for unrestricted irrigation[5].

Literature review reveals that among available chemical process for treatment of industria sewage, the chemical coagulation was very effective for textile sewage[4]. However, we suggest this process to treatment of Kashan Textile Sewage that require furthur studies (which have currently underway) to fully evaluate the performance of these type of process.

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