SEWAGE WATER QUALITY OF UNAYZAH WASTEWATER TREATMENT PLANT AND ITS SUITABILITY FOR IRRIGATION

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ABSTRACT

The Suitability of the sewage effluent from Unayzah City (Central Region of Saudi Arabia) wastewater plant for irrigation purposes was assessed during three consecutive years (1999/2000, 2000/2001, and 2001/2002) by considering some of its biochemical, physiochemical and microbiological characteristics. Processing of the available data and thereafter comparing them with the locally and the internationally acceptable standards for unrestricted and restricted irrigation revealed that: 1) the expected yearly average volume of treated sewage effluent varied from 10.9X10^6 to 38.3X10^6 m^3 which raises a high concern to the authorities regarding its disposal. 2) The effluent under the study is unacceptable for irrigation reuse in respect to the following: a) The mean BOD (range 25-34 mgL^-1), in spite of a relatively high BOD removal efficiency (range 85-97%), b) The mean COD level, which varied from 115 to 135 mgL^-1, c) The mean alkalinity level (range 290 - 298 mgL^-1), d) The mean total suspended solid contents (range 42 - 135 mgL^-1). 3) The mean electric conductivity (EC mmho Cm^-1) (range 1.65-1.65) and the mean pH value (7.3) of the effluent, however, are within the acceptable recommended quality limits for restricted irrigation. 4) The high fecal coliform count (range 1.6X10^5 - 1.2X10^6 MPN 100 ml^-1) and the high total coliform count (range 2.2X10^3 - 10X10^6 MPN 100 ml^-1) were evident thus indicating low efficiency of and incomplete microbial removal which renders the effluent unacceptable for restricted and unrestricted irrigation because of environmental and public health concern.

INTRODUCTION

Due to the recent development and population growth, municipalities and the water and sewage department in Al-Qassim Region of Central Saudi Arabia are faced with the problem of proper disposing of the ever growing volumes of wastewater that are rich in soil building properties and essential plant nutrients. The disposal sites suggested by the authorities, like Wadi Al-Ruma, were faced with intense criticism in the daily press reflecting the public opinion and concern about environmental problems in the vicinity. Previous investigators (Badr, 1984; AbdelMagid, 1995 and AbdelMagid and Al-Oud, 2000) have drawn the attention to the large amounts of treated sewage water resulting from the sewage treatment plants at Unayza and Buryah cities. Wastewater reclamation and reuse in agriculture has received much attention either locally (Roy, 1988; Al-Saat, 1995; Al-Fassi et al, 2003), regionally (Arab Water World, 1991) or internationally (Helfpenny, 1973; Madancy, 1981; Bouwer, 1981; WHO, 1990). Moreover, AbdelMagid (1999) has drawn the attention to the indispensability of treated water in the strategies of the Saudi...
Arabia water security and its importance for agriculture. He based some of his arguments on a World Bank Report (1994) indicating that sewage water represents only 0.8% of the Kingdom water needs in spite of a yearly water deficit reaching 64% in the renewable water resources. Abdula'aly and Chammem (1994) indicated that the Kingdom of Saudi Arabia is expected to reach a total consumption of water of 20 billion m$^3$ by the year 2010, 80% of which is being used for agricultural and irrigation purposes.

Recently, The Ministry of Water (MW) (2002) considered the reuse of treated sewage water. Legislative rules and standards governing the reuse are currently underway.

The objective of this study is to evaluate the biochemical, the physicochemical and the bacteriological characteristics of treated effluent from Unayzah City Wastewater Plant for irrigation reuse according to the locally and the internationally acceptable quality standards.

**MATERIALS AND METHODS**

The monthly wastewater chemical and microbiological analyses were carried out by the staff of Unayzah City Wastewater Treatment Plant laboratory. Their monthly routine wastewater data were rendered available upon the authors' request. The methods used for wastewater analyses are those recommended by the APHA (1992). The compiled data were checked, summarized and possessed to extract the most relevant information pertinent to the irrigation reuse for treated effluent recommended by the APHA (1992). The data listed in Tables 1, 2, and 3 for the influent (inf) and the effluent (eff) wastewater quantity and quality parameters were calculated from the monthly means for each of the three consecutive years used in this study, viz. 1999/2000, 2000/2001, and 2001/2002. The effectiveness of removal of the biochemical oxygen demand (BOD), chemical oxygen demand (COD), total suspended solids (TSS), alkalinity (Alk), and total coliform (TC) and fecal coliform (FC) were calculated according to AbdelMagid (1996) as follows:

\[
\text{i. Efficiency of BOD removal (\%)} = \frac{\text{BOD}_{\text{inf}} - \text{BOD}_{\text{eff}}}{\text{BOD}_{\text{inf}}} \times 100
\]

\[
\text{ii. Efficiency of COD removal (\%)} = \frac{\text{COD}_{\text{inf}} - \text{COD}_{\text{eff}}}{\text{COD}_{\text{inf}}} \times 100
\]

\[
\text{iii. Efficiency of TSS removal (\%)} = \frac{\text{TSS}_{\text{inf}} - \text{TSS}_{\text{eff}}}{\text{TSS}_{\text{inf}}} \times 100
\]

\[
\text{iv. Efficiency of alkalinity removal (\%)} = \frac{\text{Alk}_{\text{inf}} - \text{Alk}_{\text{eff}}}{\text{Alk}_{\text{inf}}} \times 100
\]
$\text{TC}_{\text{inf}} - \text{TC}_{\text{eff}}$

iv. Efficiency of TC removal (\%) = $\frac{\text{TC}_{\text{inf}} - \text{TC}_{\text{eff}}}{\text{TC}_{\text{inf}}}$ X 100

The electrical conductivity (EC) data shown in Table 2 were obtained by dividing the total dissolved solids (TDS) by 640 according to Rhoades (1982).

RESULTS AND DISCUSSION

Previous workers (Badr, 1984; AL-Saati, 1995; Moghazy and Al-Shoshan, 1999; AbdelMagid and AlOud, 2000; and AbdelMagid, 1999, 2001) have drawn the attention to the fact that the irrational and injudicious groundwater utilization in AL-Qassim region of Saudi Arabia has set the warning for over exploitation of the Saq aquifer which may result in its depletion in years ahead. Recently, a World Bank report cited by Al-Minhirawi and Hafiz (1997) and AbdelMagid (1999, 2001) revealed that the volume of the renewable water resources in Saudi Arabia was estimated at $2.2 \times 10^8$ m$^3$ year$^{-1}$ whereas the actual utilization amounts to $3.8 \times 10^5$ m$^3$ year$^{-1}$ thus resulting in 64% water withdrawal from the subsequent year’s water budget. This sets the warning for an imminent water crisis due to the dramatically increased consumption caused by the increased urbanization and expansion of agriculture and industry (Kadaj, 1991 and Abdula'ali and Chamman, 1994). Al-Saati (1995) called for the utilization of recycled water in agriculture as well as for the recharge and protection of the existing groundwater resources to avoid water crisis in the near future. He revealed that the Gulf Cooperation Council Countries utilize only 35% of the treated sewage water in both agriculture and industry. In this study the expected yearly average volume of the treated sewage effluent from Unayzah wastewater treatment plant as shown in Table 1 varied from $10.9 \times 10^5$ m$^3$ year$^{-1}$ in 200/2001 to $38.3 \times 10^5$ m$^3$ year$^{-1}$ in 2001/2002. Similarly, AbdelMagid (1996) obtained an effluent mean volume ranging from $26.4 \times 10^5$ m$^3$ year$^{-1}$ in 1991/1992 to $36 \times 10^5$ m$^3$ year$^{-1}$ in 1993/1994 for the same treatment plant. Likewise, AbdelMagid and AL-Oud (2000) obtained a mean volume of treated effluent ranging from $19.2 \times 10^5$ year$^{-1}$ in 1995/1996 and $26.4 \times 10^5$ m$^3$ year$^{-1}$ in 1997/1998 for Buraydah wastewater treatment plant. This voluminous amount of sewage effluent is raising a high degree of concern for the authorities regarding its disposal which may involve both health and aesthetic problems in the vicinity. In spite of its comparatively small volume the treated effluent produced in Unayzah and Buraydah plants may contribute significantly to recharging the exploited groundwater storage, especially in an area where irrigation water is used irrationally and injudiciously. Treated sewage effluent has been used for sprinkler irrigation in Bahrain (Al-Aradi, 1988), in Saudi Arabia (Roy, 1998), and in Qatar (Arab Water World, 1991; AbdelMagid, 2001) without causing any environmental problems.

5863
Table 1: Monthly wastewater influent and effluent volumes (m³×10⁵) wastewater treatment plants

<table>
<thead>
<tr>
<th>Total quality</th>
<th>Mean</th>
<th>Range</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1999/2000</td>
<td></td>
<td></td>
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<tr>
<td>Influent</td>
<td>3.4 (41.3)</td>
<td>3.2-3.7</td>
<td>0.18</td>
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<tr>
<td>Effluent</td>
<td>2.7 (31.2)</td>
<td>1.2-2.8</td>
<td>0.12</td>
</tr>
<tr>
<td></td>
<td>2000/2001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Influent</td>
<td>1.1 (13.1)</td>
<td>0.99-1.2</td>
<td>0.12</td>
</tr>
<tr>
<td>Effluent</td>
<td>0.92 (10.9)</td>
<td>0.81-1.01</td>
<td>0.08</td>
</tr>
<tr>
<td></td>
<td>2001/2002</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Influent</td>
<td>4.5 (51.3)</td>
<td>3.6-4.6</td>
<td>0.44</td>
</tr>
<tr>
<td>Effluent</td>
<td>3.2 (38.3)</td>
<td>2.8-3.4</td>
<td>0.16</td>
</tr>
</tbody>
</table>

Biochemical and physiochemical characteristics

The biochemical and physiochemical characteristics of the treated effluent wastewater studied for each of the three consecutive years viz. 1999/2000, 2000/2001, and 2001/2002 are reported in Table 2. The mean BOD of the effluent ranged between 25mgL⁻¹ (range 19-40 mgL⁻¹) in 1999/2000 and 34mgL⁻¹ (range 22-41 mgL⁻¹) in 2000/2001, and the mean efficiency of BOD removal due to the current treatment varied from 83% (range 75-92%) in 2000/2001 to 87% (range 82-90%) in 2001/2002. Previous assessment of the treated sewage quality of the same treatment plant (AbdelMagid, 1996) during the years 1991/1992 to 1994/1995 showed relatively lower values for the effluent BOD varying from 14.3 mgL⁻¹ in 1991/1992 to 17.8 mgL⁻¹ in 1994/1995 and an efficiency of BOD removal that varied from 89.3% in 1994/1995 to 90.8 in 1991/1992. This variation in the BOD and its removal efficiency magnitudes may be accounted for by the dramatic changes taking place in the style of living in the region over the years. According to Al-Odat and Basahi (1985), AbdelMagid (2001) and an unpublished Saudi Ministry of Agriculture and Water (MW) draft statement for maximum contamination levels the quality standard limit for the unrestricted and restricted irrigation is a BOD level of 10 mgL⁻¹ and 20 mgL⁻¹, respectively. However, the MW in 2002 prepared, according to a Royal Decree, a provisional legislative act to govern the utilization of treated sewage effluent for irrigation. According to these legislative rules the highest permissible limits for unrestricted and restricted irrigation is a BOD level of 10 mgL⁻¹ and 40 mgL⁻¹, respectively.

The COD means of the effluent as shown in Table 2 varied from 115 mg L⁻¹ (range 90-127 mgL⁻¹) in 1999/2000 to 135 mgL⁻¹ (range 131-142 mgL⁻¹) in 2001/2002. The efficiency of the COD removal varied from 65% (range 57-71%) in 1999/2000 to 70% (range 60-77%) in 2001/2002. It has been shown that the BOD of waste is almost always lower than the COD and generally only 50-70% of the UOD (Ultimate Oxygen Demand, which assumes the oxidation of all species in the waste to their oxidized stable forms) (Dupont et al, 2000). However, the COD removal efficiency is always less than that of the BOD (Table 2). No COD standard has been set by the Saudi authorities either recently (MW, 2002) or in the past. This may be
attributed to the fact that the knowledge of COD level is particularly relevant only when industrial wastes are considered and where toxicity to biological systems, as evidenced by low or no BOD, is suspected (Dupont, et al, 2000). Moreover, it may be inferred from the data for both the BOD and COD in Table 2 that the efficiency of their removal is low which implies that the sewage under study suffers from oxygen depletion which is vital for the stabilization (oxidation) of organic materials in sewage.

The total suspended solids (TSS) concentration of effluent, on the average, varied from 42 mgL$^{-1}$ (range 34-52 mgL$^{-1}$) in 1999/2000 to 135 mgL$^{-1}$ (range 130-145 mgL$^{-1}$) in 2000/2002 with a mean removal efficiency ranging between 69% (range 57-74%) in 2000/2002 and 77% (range 63-84%) in 1999/2000. The mean values of TSS obtained in this study, however, are higher than the means obtained by AbdelMagid (1996) for the same treatment plant during 1991/1992 to 1994/1995. The proposed Saudi standard limits for unrestricted and restricted irrigation is a TSS of 10 mgL$^{-1}$ and 40 mgL$^{-1}$, respectively (MW, 2002). Moreover, for unrestricted irrigation the Arizona state standards, according to Buwer and Rice (1981), recommend the reduction of both BOD and T.S.S levels to <10 mgL$^{-1}$ by tertiary treatment of wastewater. Such effluent may be used to irrigate shrubs, lawns, school grounds, private yards, sport fields and the like. It may be observed that (Table 2) the effluent under study is generally well above the highest recommended levels by the proposed Saudi Standards (MW, 2002). Therefore, it may be recommended that more detention time of sewage water in ponds is needed to bring the levels of both TSS and BOD within the range of the standard national and international quality limits. The means for the alkalinity of the effluent, as shown in Table 2, varied from 260 mgL$^{-1}$ (range 276-298 mgL$^{-1}$) in 2001/2002 to 298 mgL$^{-1}$ (range 270-356 mgL$^{-1}$) in 2000/2001. The mean efficiency for alkalinity removal varied from 15.3 mgL$^{-1}$ (range 8.5-23 mgL$^{-1}$) in 2000/2001 to 18.2 mgL$^{-1}$ (range 17.7 - 22 mgL$^{-1}$) in 2001/2002. Similarly, AbdelMagid and Al-Oud (2000) obtained low levels for the alkalinity removal efficiency in Buraydah wastewater treatment plant. Such low efficiency of alkalinity removal implies high concentration of CO$_3^{2-}$ and HCO$_3^-$ ions which have an indirect impact on sewage water quality by the precipitation of Ca$^{2+}$ and Mg$^{2+}$ and thus increasing the exchangeable sodium percentage. Mahida (1981) indicated that waters containing more than 2.5 mgL$^{-1}$ residual sodium carbonate are not suitable for irrigation. It is worth of notice that the Saudi proposed Standard (MW, 2002) licensing sewage water utilization for irrigation ignored the role of CO$_3^{2-}$ and HCO$_3^-$ as important diagnostic tools for irrigation water quality and suitability.

The salinity ranges of the effluent as indicated by the electrical conductivity (EC) mmhos cm$^{-1}$ are shown in Table 2. The means of the EC of the effluent under study varied from 1.65 mmhos cm$^{-1}$ (TDS 1056 mgL$^{-1}$) in 2001/2002 to 1.85 mmhos cm$^{-1}$ (TDS 1184 mgL$^{-1}$) in 1999/2000.
Table (2): Characteristics of influent and effluent water at Unayzah wastewater treatment plant

<table>
<thead>
<tr>
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<td>Mean 181</td>
<td>25</td>
<td>85</td>
<td>Mean 213</td>
<td>34</td>
<td>83</td>
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<tr>
<td></td>
<td>Range 141-267</td>
<td>19-40</td>
<td>84-89</td>
<td>Range 141-327</td>
<td>22-41</td>
<td>75-92</td>
</tr>
<tr>
<td></td>
<td>SD 35</td>
<td>4.6</td>
<td>1.35</td>
<td>SD 54</td>
<td>8.3</td>
<td>5.1</td>
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<tr>
<td>COD mg L⁻¹</td>
<td>Mean 329</td>
<td>115</td>
<td>65</td>
<td>Mean 418</td>
<td>117</td>
<td>70</td>
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<tr>
<td></td>
<td>Range 282-385</td>
<td>90-127</td>
<td>57-71</td>
<td>Range 230-851</td>
<td>81-148</td>
<td>60-77</td>
</tr>
<tr>
<td></td>
<td>SD 19.4</td>
<td>9.7</td>
<td>23</td>
<td>SD 133</td>
<td>17.8</td>
<td>6.0</td>
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<tr>
<td>TSS mg L⁻¹</td>
<td>Mean 197</td>
<td>42</td>
<td>77</td>
<td>Mean 158</td>
<td>68</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td>Range 228-264</td>
<td>34-52</td>
<td>63-84</td>
<td>Range 130-387</td>
<td>32-112</td>
<td>57-91</td>
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<tr>
<td></td>
<td>SD 43</td>
<td>4.4</td>
<td>6.3</td>
<td>SD 73</td>
<td>21</td>
<td>8.2</td>
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<tr>
<td>Alkalinity mg L⁻¹</td>
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<td>296</td>
<td>17.0</td>
<td>Mean 349</td>
<td>294</td>
<td>15.3</td>
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<td></td>
<td>Range 324-380</td>
<td>270-308</td>
<td>8.0-27</td>
<td>Range 312-382</td>
<td>264-321</td>
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<td></td>
<td>SD 12.5</td>
<td>7.3</td>
<td>3.5</td>
<td>SD 16.2</td>
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<tr>
<td>EC mmhos cm⁻¹</td>
<td>Mean 2.15</td>
<td>1.85</td>
<td>-</td>
<td>Mean 2.1</td>
<td>1.67</td>
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<tr>
<td></td>
<td>Range 2.08-2.31</td>
<td>1.7-2.04</td>
<td>-</td>
<td>Range 1.95-2.3</td>
<td>1.68-1.84</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>SD 0.05</td>
<td>0.03</td>
<td>0.15</td>
<td>SD 0.15</td>
<td>0.02</td>
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</tr>
<tr>
<td>pH</td>
<td>Mean 7.2</td>
<td>7.3</td>
<td>-</td>
<td>Mean 7.4</td>
<td>7.3</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Range 7.1-7.4</td>
<td>7.2-7.4</td>
<td>-</td>
<td>Range 7.2-7.6</td>
<td>7.1-7.4</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>SD 0.01</td>
<td>0.01</td>
<td>-</td>
<td>SD 0.01</td>
<td>0.01</td>
<td>-</td>
</tr>
</tbody>
</table>

* Not determined
The salinity levels obtained in this work are within the salinity limit 3 mmhos (TDS = 1920 mgL⁻¹) recommended by the FAO (1976) and the salinity limit of 2.34 (TDS = 1500 mgL⁻¹) and 3.1 mmhos (TDS = 2000 mgL⁻¹) recommended by MW (2002) for unrestricted and restricted irrigation, respectively. According to Ayers' (1975) guidelines for interpretation of water quality for irrigation no severe problems are expected from using the effluent under study for irrigation. Water with EC value of 5.3 mmhos cm⁻¹ (TDS = 3400 mgL⁻¹) was used in a similar environment in Qatar to grow fodder for milking cows (Arab Water World, 1991). Maas (1990) and Gratten and Oster (1993) indicated that the threshold irrigation water salinity for a 100% yield potential for tree crops varied from 1 mmhos cm⁻¹ (TDS = 640 mgL⁻¹) for salinity sensitive crops to 2.7 mmhos cm⁻¹ (TDS = 1728 mgL⁻¹) for salinity tolerant crops such as date palm. Moreover, several classifications were suggested for irrigation waters for salinity hazards ranging from an EC value of 0.78 mmhos cm⁻¹ (TDS = 500 mgL⁻¹ - no salinity problems) to an EC value of 7.8 mmhos cm⁻¹ (TDS = 5000 mgL⁻¹ - severe salinity problems) (Clark et al, 1963, Ayres, 1975 and Mahida, 1981). The suitability of such water, however, will depend on climatic factors, soil type and crop tolerance.

The pH value of the effluent under study, as shown in Table 2, ranged from 7.1 to 7.4 with a mean value of 7.3 for all years of study. These values are within the standard limits of 6-8.5 for both unrestricted and restricted irrigation (Al-Odat and Basahi, 1985 and MW, 2002).

It is evident from the data presented in Table 2 that the effluent under study is of an unacceptable quality with respect to its BOD, T.S.S and alkalinity levels. Therefore, more detention time is needed to bring the levels of these parameters within the range of the national as well as the international standards and may accomplish significant virus removal as well (Peachem et al, 1978 and Kott et al, 1978). It may, therefore, be mentioned that disposing of such effluent in the vicinity of cities in wadis, as is currently practiced, warrants more attention in view of the environmental, health and aesthetic problems encountered.

**Bacteriological characteristics:**

The bacteriological characteristics measured in this study are the fecal coliform and the total coliform population expressed as the most probable number (MPN) per 100ml (Table 3). It may be observed that even after achieving a mean removal of 99.99% for both the fecal and total coliforms, the final effluent still contained between 1.6×10³ and 1.2×10⁴ MPN100 ml⁻¹ fecal coliform count and between 2.2×10⁸ and 1.1×10⁹ MPN100 ml⁻¹ total coliform count. The counts of both total coliforms and fecal coliforms fall within the unacceptable range of bacteriological standard for unrestricted and restricted irrigation reuse of sewage water as proposed by Saudi authorities (Al-Marshou and Khan, 1982; Al-Odat and Basahi, 1985 and MW, 2002). In USA Bouwer and Rice (1981) indicated that for unrestricted irrigation the State of California requires the effluent to be adequately disinfected so that 7-day median coliform count not in excess of 2.2 MPN100ml⁻¹ and 30-day maximum coliform count not in excess of 23 MPN 100ml⁻¹.
<table>
<thead>
<tr>
<th>Parameter (MPN 100L⁻¹)</th>
<th>Fecal coliform Mean</th>
<th>SD</th>
<th>Range</th>
<th>Total coliform Mean</th>
<th>SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Influent</td>
<td>8.5X10⁴</td>
<td>1.2X10⁴</td>
<td>99.7-99.99</td>
<td>1.1X10⁵</td>
<td>1.2X10⁴</td>
<td>99.7-99.99</td>
</tr>
<tr>
<td>Effluent</td>
<td>8.2X10⁴</td>
<td>1.2X10⁴</td>
<td>99.9</td>
<td>1.1X10⁵</td>
<td>1.2X10⁴</td>
<td>99.9</td>
</tr>
<tr>
<td>Influent</td>
<td>7.4X10⁴</td>
<td>2.7X10⁴</td>
<td>99.9</td>
<td>1.1X10⁴</td>
<td>2.7X10⁴</td>
<td>99.9</td>
</tr>
</tbody>
</table>

Table (3): Fecal and total coliform bacteria content of influent and effluent water at Unayzah wastewater treatment plant.

5868
Al-Turki, A. I.

The Arizona State requirements for unrestricted irrigation are even more stringent that the effluent should contain a coliform count of 2.2 MPN 100ml$^{-1}$ with no single sample to exceed a count of 25 MPN 100ml$^{-1}$. With sufficient control and strict supervision on the irrigation system both California and Arizona States allow the irrigation of fodder, fiber, and seed crops and orchard and vine yards using primary effluent.

It may be concluded that the salient features of the findings of this work imply that the effluent water studied is of an unacceptable quality with respect to its BOD, T.S.S., and alkalinity levels as well as its bacteriological characteristics. Therefore, it is recommended that the shortcomings pointed out in this study must be taken into consideration by the authorities before effluent water is used for irrigation or disposed of on lands or in wadis in the vicinity of urban areas. Re-evaluation of sewage effluent treatment warrants needs more attention in order to avoid environmental, health, and aesthetic problems.

ACKNOWLEDGEMENT

The author wish to acknowledge the cooperation and assistance of the Water and Sewage Authority of Al-Qassim Region, Saudi Arabia, during the course of this work.

REFERENCES


Al-Turki, A. I.


نوعية مياه الصرف الصحي المعالجة في محطة عنيزة ومدى صلاحيتها للزرواعي

أحمد بن إبراهيم التركي
قسم إنتاج النباتات ووفياته - كلية الزراعة والطب البيطري - جامعة الملك سعود - فرع القصيم -
صب ب 1482 بريدة - المملكة العربية السعودية.

في البحت تم تقسيم مدي صلاحية مياه الصرف المعالجة في محطة الصرف الصحي في محافظة عنيزة بالمنطقة الوسطى من المملكة العربية السعودية لـ 3 سنوات متناوبة هي 2000/2001 و 2001/2002 وذلك بتغير خواص مياه المعالجة الكيميائية والميكروبيولوجية والبكتيريولوجية ومراقبتها بالمواصفات التشريوية المحلية والعالمية. فالمصادر المتبعة عليها بعد معالجتها ومتقيرها بالمواصفات التشريوية المحلية والعالمية لـ الصرف الصحي علي مايلي: (1) أن الحجم السنوي للمياه الخارجية من محطة المعالجة يتراوح بين 10.9 × 10⁵ m³ إلى 38.3 × 10⁵ m³.

(2) المياه المعالجة تحت دراسة. هي صلاحية للزراعي المعدي وغير المعدي بالنسبة للقياسات التالية: (a) متوسط الأكسجين الجوي المتطلبه (BOD) الذي يراوح من 25 إلى 34 mg L⁻¹ والذي يمتلك هذه المياه غير صلاحية للزراعي المعدي وغير المعدي بمراعاة من المياه المعالجة الذي يتراوح من 63 إلى 83% (b) متوسط الأكسجين الكيماوي المطلوب (COD) والذي يراوح من 115 إلى 135 قيم (mg L⁻¹) (c) متوسط الالتقص (EC) الذي يراوح من 298 إلى 317 مللي غاما. (d) البوتاسيوم (K) الذي يراوح من 3.135 إلى 4.2 مللي غاما.

(3) فاصلة التوصل الكهربائي (pH) تراوح من 6.5 إلى 7.3 (4) قيم التوصيل الكهربائي (µmhos/cm) تراوح من 1.65 إلى 1.85. (5) تراوح من 103 و 104 MPN 100ml⁻¹. (6) عدد بكتيريا الفاولون البلازمية تراوح من 2.2 × 10³ إلى 2.101 × 10⁴ MPN 100ml⁻¹. (7) تراوح من جسم خضار كفاءة إزالة الميكروبات من مياه الصرف الصحي بنسبة 99.99%.

بوضوح على انخفاض كفاءة إزالة الميكروبات من مياه الصرف الصحي ونفس المقدمة مما تسبب هذه الماء من أمراض على البيئة والصحة العامة.