Water Audit Report
2016
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Executive Summary

This report deals with the “Water Audit” of M/S Rantex (Pvt.) Ltd. located at 42 KM Sheikhupura Road, Faisalabad. It was the intention of management of Rantex Pvt. Ltd. to quantify the amount of water used by their industry. For said purpose water audit of industry was carried out. Industrial Process water demand and domestic water demand was determined. Industry survey was carried out for benchmarking of water consumption and data collection. Flow meters has properly installed in the industry. Domestic and industrial water consumption data has been provided for the year 2016 by the management team of Rantex.

Based on the data & information provided by the management of Rantex Pvt. Ltd, it is determined through audit that in current scenario domestic water consumption is 14% and industrial process water consumption is 84%, and 2% is get lost. Some leading water conservation practices have been implemented in Rantex in year 2017.

Based on the quantification of water consumption in Rantex Pvt. Ltd. potential saving has been recommended. Major water saving plans includes; water conservation in boiler by condensate return system, installation of rain harvesting system, modification in washing process, installation of flow fixtures to control flow of water, installation of leakage detection sensors and some other general recommendations. The impact of water conservation plan on operational and financial key performance indicator has also been evaluated.

The above describe task was completed by experts of;

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About RANTEX
Rantex Private Limited was formed and incorporated in 1990 to setup a vertically integrated manufacturing facility to produce and export denim fabric globally.

The factory is located at 42 KM Sheikhupura Road, Faisalabad which is in the vicinity of Faisalabad. The covered area of factory is approximately 310,000 square feet.

Rantex Private Limited is capable of manufacturing a diversified range of Denim Fabric. The management team of Rantex Private Limited comprises of dedicated and highly motivated individuals, laying much emphasis on teamwork and interdependency, which brings synergetic results. They bring with them, experience in the Denim industry, diverse educational backgrounds, both local and international experience. Rantex Private Limited has tried to develop a culture where quality is given the top priority, innovation is encouraged, systems are religiously followed and inspection procedures are adopted at every stage of production. The amazing fusion of R&D and PD team leads them to produce denim fabrics ahead of the trends and produce goods which are “Crafted to Last”

The Product Development Department of Rantex is an efficient force of highly talented individuals assisting the clients in the reorganization of the most heard about latest trends which are driven from a comprehensive study of the most inspirational and influential designers and denim exhibitions all through the globe.

Rantex with current production capacity of 1.6 million meters a month is a fast growing company where they aim to reach a mark of 3 million meters by 2018 for Denim Fabrics.
Yet another unique feature at Rantex is the capability of producing Non Denim Twills, along with Light Weight Denim fabrics with a dedicated capacity of 2 Million meters a month. This all has only been possible by strong confidence and entrust from their customer and they look forward to strengthen their reputation.

With the use of the most modern and advance technology in their production processes they have very uniquely positioned themselves as strategic partners to world leading brand labels and with their increasing capacities they look forward to add more potential partners to their business portfolio.

Their lean and high efficient supply chain & procurement systems allow them to deliver outstanding value as well as unbeatable rapid pace to their customers from purchase order to goods in warehouse.

**Key Facts of the Industry:**

<table>
<thead>
<tr>
<th>Name of Industry</th>
<th>Rantex Pvt. Ltd</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit Address</td>
<td>42 KM Sheikhpura Road, Faisalabad</td>
</tr>
<tr>
<td>Total Area</td>
<td>75526 m²</td>
</tr>
<tr>
<td>Roof Surface Area</td>
<td>24075 m²</td>
</tr>
<tr>
<td>Total Production</td>
<td>1.6 million meter per month</td>
</tr>
<tr>
<td>Product Category</td>
<td>Jeans</td>
</tr>
<tr>
<td>Water Source</td>
<td>Turbine 2 Nos. Capacity: 2 cusecs</td>
</tr>
<tr>
<td>Overhead Water Storage Capacity</td>
<td>8000 gallons</td>
</tr>
<tr>
<td>Unit Price of water withdraw</td>
<td>Rs. 6.5/- per m³</td>
</tr>
<tr>
<td>Unit Cost of Raw water treatment</td>
<td>Rs. 6.5/- per m³</td>
</tr>
<tr>
<td>Unit Price of water treatment</td>
<td>Rs. 6.3/- per m³</td>
</tr>
<tr>
<td>Water Treatment Plant Capacity</td>
<td>1800 m³ / day</td>
</tr>
</tbody>
</table>
Boiler

Total Staff Strength

Rantex Private Limited is currently structured around major departments, which are as follows:

- Weaving
- Rope Dying
- Finishing
- Sizing
- Inspection
- Packing
- Mercerizing
- PPC
- Quality Assurance & Control
- Health, Safety & Environmental Department
- Human Resource/Administration

**Process Flow Diagram:**

At Rantex to weave dreams and inspirations of clients into a tangible reality, raw material is passes through following process. The below process flow diagram show the detail process detail occurring at Rantex.
Figure 9 Layout Map of Rantex Pvt. Ltd.
Water Audit of RANTEX
Water is one of the most valuable resources and the lifeblood for sustained economic development of any country. Pakistan, sixth largest country in the world with a population of 2.48% of the world’s total population, is developing with high and medium growth rate of population and industrial activity respectively.

Hasty urbanization and growing industrial units are showing increasing trend in water demands. The ground water table is going down due to unsustainable utilization of water resources. It is reported that 96% of available water is being used for agriculture, 2% for industrial and the remaining 2% is used by the domestic sector.

It is reported that industrial water demand in Pakistan will increase two times from 1.44 Billion Cubic Meter (BCM) in year 2002 to 2.88 BCM by the year 2025. Ministry of Water and Power (2004) reports that industrial water demand will increase by 1.6 times from 2.7 BCM in year 2000 to 4.3 BCM in year 2025. United Nations Development Programme estimates Pakistan’s current water availability as 1,090 m$^3$ per capita per year.

Textile is the largest industrial sector of Pakistan with respect to production, export and labor force employment. Pakistan is the 8th largest exporter of textile products among Asian countries and 12th globally. The textile industry is water intensive industry and most of the water is consumed for cleaning the raw materials, dyeing, washing, printing and various other production processes. Therefore, water consumption varies among processes, machine types and setups within a textile mill. In a textile mill, wet processing that includes pre-treatment, dyeing, and finishing typically accounts for the majority of water consumption and wastewater discharge.

For conservation of water resource industries have to quantify their water demand, after this quantification water conservation plan is applied. The technique use to quantify the water inputs and out of industry is water audit.

A water audit (also known as an assessment) is systematic survey of all water-using fixtures, appliances, equipment, and practices at a facility or
campus. A thorough water use audit is the basis of a water use efficiency improvement plan and sets the foundation for the entire effort.

The purpose of water audit is to:

- Benchmarking of water consumption
- To identify the water consumption trend
- To identify the areas of extensive water consumption
- To identify industrial and domestic water consumption per day
- To identify un-accounted water e.g. leakages
- To develop a complete water balance diagram
- To suggest water conservation plan
- To evaluate the impact of conservation plan on key performance indicators

**Data Acquisition Plan:**

Water audit survey was carried out according to following plan;

Survey Date : 05-June-2017
Starting time : 09: 00 am
Completion time : 05: 00 pm
Survey duration : 8.00 hours

The key components in the water audit methodology undertaken for the Rantex Pvt. Ltd included;

**Pre-Audit Information**

- Preliminary literature review of concepts and methodologies related to water audit for industrial processes and domestic usage.
- Walk through the entire industry to identify the nature of water uses and the systems installed in the industry, water supply and discharge system and process machinery metering system.
- Consultation with industry’s administrative person for data and documentation collection.
Conducting Water Audit; Base-lining and Benchmarking
The water audit for Rantex Pvt. Ltd includes data collection for various identified water uses areas. Water using areas includes domestic usage and industrial processes. Data collection includes:

- Collecting records of water pumped to the overhead tanks, average bore well withdrawals, to estimate actual supply.
- Amount of water entering and exiting each industrial process.
- Amount of water use for domestic purposes.
- Amount of water entering ETP.
- Quality of treated wastewater to be discharged to drain.

Analysis of Audit Results
After conducting above benchmarking and data collection, next phase is to analyze and representation of results. On the base on these results, water conservation plans has to be suggest which. All the data is collecting for the base year of 2016.

All water audit data was represented graphically and in tabular form. And a water balance diagram was developed which show the detail water consumption of industry.
**Water Audit Results:**

**Water Supply and Water Consumption Pattern:**

The main source of water supply is bore well with two turbine of capacity of 2 cubic feet per second, one turbine at stand by mood. The water from well is stored into overhead tank of capacity 8000 gallons. The water is transmitted to whole industry through overhead tank.

Flow meters has installed for continuous recording and monitoring of amount of water withdraw.

![Water Turbine and Flow Meters](image)

For proper measurement and monitoring of wastewater, flow meter is installed at final discharged point in October 2016. Water used in industrial processes and for domestic purposes is transmitted into effluent treatment plant after usage. Rantex has effluent treatment plant of capacity 1800 m³ per day. After the treatment water is drain into nearby water body. Wastewater quality after treatment meets the Punjab Environmental Quality Standards.

Water withdraws record for base year is given in Table 1. Variation in water consumption demand and fabric production is show graphically and represented as Graph 1.
Quantity of Water consumption for industrial process and domestic use was analyzed from water audit data collection.

Water consuming processes are benchmarked in below process flow diagram.

Above dashed line areas are water consuming areas. Other than these benchmarked processes, water is consumed in boiler for production of steam. In dyeing and sizing water is also used for washing the fabric. Currently industry has two dyeing machine one is in working mode one for standby mode.
Meters are installed on all process machines and on water lines for proper recording of water being consumed.

Table 1 Amount of water withdraw, discharged and fabric produced for year 2016

<table>
<thead>
<tr>
<th>Month</th>
<th>Amount of Water Withdraw per month m³</th>
<th>Amount of Water Discharge per month m³</th>
<th>Fabric Production in 100 m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan-16</td>
<td>49152</td>
<td>-</td>
<td>14451.36</td>
</tr>
<tr>
<td>Feb-16</td>
<td>45999</td>
<td>-</td>
<td>13610.25</td>
</tr>
<tr>
<td>Mar-16</td>
<td>47795</td>
<td>-</td>
<td>13931.75</td>
</tr>
<tr>
<td>Apr-16</td>
<td>44668</td>
<td>-</td>
<td>13344.09</td>
</tr>
<tr>
<td>May-16</td>
<td>52285</td>
<td>-</td>
<td>15105.05</td>
</tr>
<tr>
<td>Jun-16</td>
<td>50192</td>
<td>-</td>
<td>14859.29</td>
</tr>
<tr>
<td>Jul-16</td>
<td>48954</td>
<td>-</td>
<td>14087.35</td>
</tr>
<tr>
<td>Aug-16</td>
<td>51769</td>
<td>-</td>
<td>15110.33</td>
</tr>
<tr>
<td>Sep-16</td>
<td>53387</td>
<td>-</td>
<td>15935.54</td>
</tr>
<tr>
<td>Oct-16</td>
<td>48212</td>
<td>44835</td>
<td>13965.03</td>
</tr>
<tr>
<td>Nov-16</td>
<td>37225</td>
<td>33637</td>
<td>10420.14</td>
</tr>
<tr>
<td>Dec-16</td>
<td>29896</td>
<td>25753</td>
<td>8503.22</td>
</tr>
<tr>
<td>Average</td>
<td>46627</td>
<td>37741</td>
<td>13610</td>
</tr>
</tbody>
</table>

Graph 1 Variation in water consumption demand for year 2016
In Rantex water demanding industrial processes, huge amount of water has been used in dyeing process. Table below shows the water demand of each industrial process. Water demand of water consuming process is also shown in below given pie-chart.

Table 2 Water consumption in industrial process

<table>
<thead>
<tr>
<th>Month</th>
<th>Dyeing m3</th>
<th>Water In</th>
<th>Water Out</th>
<th>Water In</th>
<th>Water Out</th>
<th>Water In</th>
<th>Water Out</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan-16</td>
<td>24556</td>
<td>8349</td>
<td>24310</td>
<td>8266</td>
<td>2482</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feb-16</td>
<td>22999</td>
<td>7819</td>
<td>22769</td>
<td>7741</td>
<td>2318</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mar-16</td>
<td>23883</td>
<td>8120</td>
<td>23644</td>
<td>8039</td>
<td>2484</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apr-16</td>
<td>22284</td>
<td>7577</td>
<td>22061</td>
<td>7501</td>
<td>2318</td>
<td></td>
<td></td>
</tr>
<tr>
<td>May-16</td>
<td>26043</td>
<td>8854</td>
<td>25783</td>
<td>8765</td>
<td>2708</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jun-16</td>
<td>25051</td>
<td>8517</td>
<td>24800</td>
<td>8432</td>
<td>2605</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jul-16</td>
<td>24327</td>
<td>8271</td>
<td>24084</td>
<td>8188</td>
<td>2530</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aug-16</td>
<td>25835</td>
<td>8784</td>
<td>25577</td>
<td>8696</td>
<td>2687</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sep-16</td>
<td>26544</td>
<td>9025</td>
<td>26279</td>
<td>8935</td>
<td>2760</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oct-16</td>
<td>24056</td>
<td>8179</td>
<td>23815</td>
<td>8097</td>
<td>2502</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nov-16</td>
<td>18563</td>
<td>6311</td>
<td>18377</td>
<td>6248</td>
<td>1930</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dec-16</td>
<td>14933</td>
<td>5077</td>
<td>14784</td>
<td>5026</td>
<td>1553</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>23948.58</td>
<td>8084.42</td>
<td>23709.10</td>
<td>8003.57</td>
<td>2482.43</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Graph 2 Average Industrial Water consumption demand in m$^3$ per month
Domestic water is consumption includes water used for drinking, washing & cleaning, in mosque, in washrooms, in kitchen for tea making and for watering the plant. After the usage water is discharged into ETP for treatment and after treatment discharged to final drain. Domestic water demand in Rantex for the year of 2016 is given in below table.

Table 3 Domestic Water consumption for the year 2016

<table>
<thead>
<tr>
<th>Month</th>
<th>Water Used in washrooms , cleaning , Masjid, Mopping m3</th>
<th>Water Used for watering the plants m3</th>
<th>Water used in kitchen for Meal , Tea &amp; Drinking m3</th>
<th>Water used for construction m3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan-16</td>
<td>3438</td>
<td>2947</td>
<td>2456</td>
<td>982</td>
</tr>
<tr>
<td>Feb-16</td>
<td>3220</td>
<td>2760</td>
<td>2300</td>
<td>920</td>
</tr>
<tr>
<td>Mar-16</td>
<td>3344</td>
<td>2866</td>
<td>2388</td>
<td>955</td>
</tr>
<tr>
<td>Apr-16</td>
<td>3120</td>
<td>2674</td>
<td>2228</td>
<td>891</td>
</tr>
<tr>
<td>May-16</td>
<td>3646</td>
<td>3125</td>
<td>2604</td>
<td>1042</td>
</tr>
<tr>
<td>Jun-16</td>
<td>3507</td>
<td>3006</td>
<td>2505</td>
<td>1002</td>
</tr>
<tr>
<td>Jul-16</td>
<td>3406</td>
<td>2919</td>
<td>2433</td>
<td>973</td>
</tr>
<tr>
<td>Aug-16</td>
<td>3617</td>
<td>3100</td>
<td>2583</td>
<td>1033</td>
</tr>
<tr>
<td>Sep-16</td>
<td>3716</td>
<td>3185</td>
<td>2654</td>
<td>1062</td>
</tr>
<tr>
<td>Oct-16</td>
<td>3368</td>
<td>2887</td>
<td>2406</td>
<td>962</td>
</tr>
<tr>
<td>Nov-16</td>
<td>2599</td>
<td>2228</td>
<td>1856</td>
<td>743</td>
</tr>
<tr>
<td>Dec-16</td>
<td>2091</td>
<td>1792</td>
<td>1493</td>
<td>597</td>
</tr>
<tr>
<td>Average</td>
<td>3256.00</td>
<td>2790.75</td>
<td>2325.50</td>
<td>930.17</td>
</tr>
</tbody>
</table>
Average amount of water required in different categories of water consumption is calculated on the basis of provided one year data. Variation in water demand in different areas of water consumption is shown in the below graph.

![Graph 4 Average Domestic Water Demand in m³ per month](image1)

**Graph 4 Average Domestic Water Demand in m³ per month**

![Graph 5 % Domestic Water Consumption Demand](image2)

**Graph 5 % Domestic Water Consumption Demand**

On the basis of water audit result analysis, approximate monthly water demand of Rantex Pvt Ltd is estimated. Estimated water demand results are given in below table;

**Table 4 Average Water Consumption per Month**

<table>
<thead>
<tr>
<th>Water Use Type</th>
<th>m³/month</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process Water Demand</td>
<td>37209.00</td>
</tr>
<tr>
<td>Domestic Water Demand</td>
<td>9302</td>
</tr>
<tr>
<td>Un-accounted Losses</td>
<td>116.00</td>
</tr>
</tbody>
</table>
Water balance diagram for Rantex Pvt Ltd is given below as Figure 9. This water balance diagram shows the amount of water entering the process and the amount of water leaving the process. It also represent the amount of water withdraws in a month along with amount of water treated in ETP in one month.

Water Consumption tracking Results;
- Average Amount of Ground Water Withdraw in a year is 0.548 Million m$^3$.
- Average Amount of water used for Industrial Process in a year is 0.446 Million m$^3$.
- Average Amount of water used for domestic purposes in a year is 0.100 Million m$^3$. 
After the usage water is discharged to the effluent treatment plant. Quantity and quality of effluent is properly monitored. For quantification of wastewater flow meters has been installed. For quality analysis sample has been analyzed by certified laboratories periodically. Sample after treatment meets the Punjab Environmental quality standards. As this water does not have any harmful effect on environment so it is safe to discharge it into nearby water body. The evidence prove of wastewater quality is given below;

Figure 12 Pictorial Evidence of Wastewater Quality
Quantification analysis of wastewater proves that average amount of wastewater being discharge in a normal day is 1365m$^3$.

The criteria pollutants concentrations are as follow:

- pH: 7-8
- COD: <150
- BOD: <80
- TDS: <3500
- TSS: <200
Water Conservation Practices in Rantex:
Rantex Pvt Ltd. has implemented many plans for conservation of water and reduction in water used. Worker awareness training programs are also organized to make them aware about good house keepings. These awareness trainings prove very successful for water conservation. Some of the leading water reduction practices implemented in Rantex Pvt. Ltd are:

- Rantex Pvt. Ltd has recently installed Morison Rope Dyeing Machine to reduce water leakage. Previously installed dyeing machine has three dryer whereas Morison Rope Dyeing Machine has four dryer which will reduce water leakage. Target reduction through this practice is decided up to 5%. Currently Rantex Pvt. Ltd has achieved 2% reduction in water wastage through this practice.

- Two chemical dyes EM Soft and Exoline Pad have been replaced by NPOS and APOS respectively. Formerly used dyes required large amount of water. This practice is implemented from May 2017. Target is to reduce water consumption up to 2%. Currently 0.5% reduction in water consumption is achieved.

- During dyeing process Decol chemical is start using for removal of water hardness since May 2017. This will reduce water consumption upto 2%. Current achievement through this practice is 0.5%.

- For finishing operation, mercerizing machine has been installed since February 2017. This also proves a leading practice for water reduction.

- For improvement in wastewater quality, Rantex is working on enhancement of effluent treatment plant capacity. Extension in existing treatment plant will be done to improve the quality of wastewater being discharged and also to bear the load. Proposed plant will have the capacity to treat wastewater flow of 3000m$^3$/day. Prefeasibility study of proposed treatment plant has also been done and it proves efficient treatment. Pilot scale study of proposed treatment shows that after this treatment, wastewater will meet PEQS.
limits and BSR standards as well. Evidence proof of this operation improvement is given below;

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**Effluent Treatment Plant**
*Origin: Textile process*  
*Inlet flow: 3,000 m³/d*

---

**RANTEX PVT LTD.**  
*Pakistan*

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**4 HIGH EFFICIENCY REACTOR**

**LONG AERATION BIOLOGICAL TREATMENT**

The aerated biological treatment consists of an aerator tank where bacteria are directly in contact with the effluent to be treated. This biological treatment with aerated plants allows the transformation of polluting substances of organic and inorganic nature contained in waste water, into carbon dioxide and stabilized sludge. This phenomenon is achieved due to oxygen injected into water that allows the survival of the bacteria necessary to the decolourization process.

Effluent coming from dye house are efficiently decolourized by long aerated biological treatment, a particular scheme where the waste water is treated in the aerator tank. For a long term of time that, normally between 30 and 80 hours, depending on the type of pollutant to remove and its quantity.

The long aerated biological treatment has the following advantages:

- **Stability of plant functioning and elasticity of working referring to quality and quantity of biodegradable pollutants;**
- **Lowest operational costs** for the treatment (compared with other treatment);  
- **Minimization** of the excess sludge generation with reduction of disposal cost;  
- **Stabilization** and **mineralization** of the excess sludge for a simplified stockage;  
- **Easy maintenance** and reduced labour force, because of the extreme stability of the process;

Moreover possible, biological technology is preferable to others because it guarantees the lowest running cost and environmental friendly.

SMPH with a continuous researching of the improvement has optimized the scheme with an energy saving system by employing a new concept of an diffusion described in the next chapter.

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**ENERGY SAVING SYSTEM**

Energy efficiency is today a primary goal for all enterprises, saving money makes your Company more competitive.

Considering 10 years life of an air diffusing system, below graph the cost for the energy consumption represent the 75% of the total air diffusing cost (investment + consumption + maintenance).

Numbers evidence that electricity costs are 3 times more than investment cost, so by investing in this sector is possible to realise a considerable total cost reduction.
5. CHARACTERISTICS OF WATER

The dimensioning of the following plant has been developed according to the multi-year experience of SIMEM in the design of water treatment plants in similar cases. The water treatment plant will be carried out for a process composed as listed in the previous point 3.4. This kind of wastewater is biodegradable, and therefore they justify the selection of a biological treatment with activated sludge.

- Inlet and outlet PARAMETERS

Results of laboratory analysis on similar cases revealed the following characteristics:

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Inlet</th>
<th>Outlet from cloth filter</th>
<th>Limits as per ISIR Standards</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow</td>
<td>3000</td>
<td>3000</td>
<td></td>
<td>m³/dw</td>
</tr>
<tr>
<td>BOD₅</td>
<td>&lt; 1000</td>
<td>≤ 30</td>
<td>≤ 30</td>
<td>mg/L</td>
</tr>
<tr>
<td>COD</td>
<td>&lt; 2000</td>
<td>≤ 150</td>
<td>≤ 200</td>
<td>mg/L</td>
</tr>
<tr>
<td>Suspended solids</td>
<td>200</td>
<td>≤ 30*</td>
<td>≤ 30</td>
<td>mg/L</td>
</tr>
<tr>
<td>Temperature</td>
<td>50</td>
<td>≤ 30</td>
<td>≤ 37</td>
<td>°C</td>
</tr>
<tr>
<td>pH</td>
<td>11-12</td>
<td>7-8.5</td>
<td>6.0-9.0</td>
<td></td>
</tr>
<tr>
<td>Colour</td>
<td>1500</td>
<td>&lt; 150**</td>
<td>&lt; 150</td>
<td>PF-CoL</td>
</tr>
<tr>
<td>Oil and fat</td>
<td>&lt; 20</td>
<td>≤ 5</td>
<td></td>
<td>mg/L</td>
</tr>
<tr>
<td>Ammonia (NH₃)</td>
<td>15-25</td>
<td>≤ 10</td>
<td></td>
<td>mg/L</td>
</tr>
<tr>
<td>TDS</td>
<td>3500</td>
<td>***</td>
<td></td>
<td>mg/L</td>
</tr>
</tbody>
</table>

The plant has been dimensioned following the above mentioned data that will have to be taken into strict control during treatment and efficiency checks.

*NOTE: to reach this limit is mandatory the installation of cloth filter.

**NOTE: Data obtained with decaolention reagent use: its quantity of dosage of per depends of reagent supplier.

***NOTE: A biological plant has no reduction effect on dissolved salts, except for a natural absorption and adsorption effect. The TDS value is affected by the pH correction system with sulphuric acid. The estimated closing is really low, so as per design it cannot affect sensibly the discharge value.

Figure 14 Pictorial Evidence of ETP Extension Contract

Table 5 Leading Water Conservation Practices in Rantex

<table>
<thead>
<tr>
<th>Leading Practice</th>
<th>Target</th>
<th>Target achieved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installation of Morison Rope Dyeing Machine</td>
<td>5% Reduction in water leakage</td>
<td>2% reduction</td>
</tr>
<tr>
<td>Replacement of dyes chemicals</td>
<td>2% Reduction in water consumption</td>
<td>0.5% achieved</td>
</tr>
<tr>
<td>Removal of water hardness</td>
<td>2% Reduction in water consumption</td>
<td>0.5% achieved</td>
</tr>
<tr>
<td>Installation of Mercerizing Machine</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Enhancement in effluent treatment plant</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>
Proposed Water Consumption Reduction Plans:
Water audit techniques was adopted to quantify the amount of water consumption so that based on these quantifications, an efficient water management/reduction plan should be developed to improve the overall industry efficiency. Efficient technique that should be adopted after auditing is 3R strategy.

Industry is currently is treating its process wastewater onsite and after treatment it discharge into nearby water body. The treatment plant of capacity 75 m³/hr is already exists in industry and biochemical treatment of process wastewater is carried out.

Some amount of withdraw water get losses. These losses include leakage water through joints, valves and fittings. In current situation water spillage from machines was observed during audit survey. This spillage was due to mismanagement in operation.

1. Water Conservation through Rainwater Harvesting System:

Rainwater harvesting means the activity of direct collection of rain water which can be recharged in to the ground water to prevent fall of ground water level or storing in surface or underground water tank. It is the most scientific and cost effective way of recharging the ground water and reviving the water table. It offers advantage in water quality for both Plantation and domestic use e.g. flushing toilet and car wash etc. The ultimate use of this collected water is depending on consumer.

Rainwater harvesting can be carried out by following techniques;

1. Storing rainwater for direct use
2. Recharging ground water aquifer with ground/roof runoff

Direct use of water includes water used for watering green areas, flushing toilets, floor cleaning and car washing etc.

Rainwater harvesting system includes on:
- Catchment area i.e. the surface area utilized for capturing the rainwater (roof surface area)
• Collection device, like tanks or percolation pits used for collecting or holding the water.
• Conveyance system i.e. the system of pipes through which water is transported from the catchment area to the collection device.

Amount of water that can be harvest is determined by catchment area, average annual rainfall and co-efficient of rainfall depending upon type of surface. The roof runoff assessed for designing the harvest structure and this amount is assessed by following formula.

\[
\text{Runoff} = \text{Catchment area} \times \text{Runoff Coefficient} \times \text{Rainfall}
\]

\[
\text{Runoff} = 24075 \times 0.9 \times 628.8
\]

\[
\text{Runoff} = 13624 \text{m}^3/\text{yr}
\]

However, in practice, this volume can never be achieved since a portion of the rainwater evaporates from then roof surface and a portion may be lost to the drainage system. Thus, the net usable or available amount of rainwater from the roof surface would be approximately 70% to 80% of the gross volume of rainfall. In the current situation, the actual usable amount of rainwater would be about 9537 m³ to 10899 m³ in a year. This collected amount of rain water can be used for direct use and it may also be used for ground water recharge. Both the re-use option has been recommended.

If this amount of rainwater will be used for recharging the ground aquifer/bore well, then there will be no financial saving because electricity charges still has to pay for withdraws of water. But this will sustain our natural resource of water.

In other words, water will raise the ground water table and increase availability of water. The estimated cost of installation of system for ground water recharging is Rs. 1,16,729/- to Rs. 1,71,203/-.

For direct use of rainwater, a storage tank has to be constructed to store rain water and then this stored water will be transfer for desired used. The storage tanks can be constructed on surface or below surface.
The thumb rule for designing of storage tank is; “build a storage tank of bottom area equal to the one third area of the roof top and the depth of the tank equal to three times the average annual rainfall in meter or three meter whichever is less.” The recommended size of storage tank is 89m×89m×1.88m. Thus the storage capacity of tank will be 14891m$^3$ per year.

The cost analysis of recommended rainwater harvesting system for direct use shows that:

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost (Rs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual saving for water withdraw</td>
<td>70,843/-</td>
</tr>
<tr>
<td>Annual saving for wastewater treatment</td>
<td>70,843/-</td>
</tr>
<tr>
<td>Estimated Installation cost of rainwater collection system</td>
<td>1,12,060/-</td>
</tr>
<tr>
<td>Payback period</td>
<td>1.26 years</td>
</tr>
<tr>
<td>Base Year</td>
<td>2018</td>
</tr>
<tr>
<td>Target Year</td>
<td>2019</td>
</tr>
</tbody>
</table>

2. **Boiler Condensation Return System:**

Water is supplied to boiler for steam generation purpose. This steam produced is direct applied to the manufacturing process for heating purpose. When steam transfers its heat in a production process or used in heating a coil or heat exchanger, it converts into liquid phase. This phase of steam is called condensate.

A huge amount of water can be saved in boiler and steam system through installing condensate recovery system. This system returns the condensate after recovery to boiler as feed water with addition of makeup water. As more condensate will be return, less make up water will be needed. This will reduce fuel cost, make up water cost, chemical and treatment cost.

A major opportunity for water savings in boiler and steam systems is through improving the efficiency of condensate water return to the boiler. As more condensate is returned, less make up water is needed. The reuse of high purity condensate water reduces the amount of water required.
Return of high purity condensate also reduces energy losses due to boiler blow down. Water use in boiler and steam systems, where temperatures and pressures vary, is typically accounted for in units of pounds (lbs) per hour.

When condensate return is implemented or improved and operating hours are known, the amount of water saved in gallons can be found by 
\[
\left( \frac{\text{condensate load in lbs/hr} \times \text{annual operating hours}}{8.34} \right)
\]
As less or no condensate will be drain so it will reduce treatment cost. Fuel cost will be reduce as most condensate return will be relatively hot so reduce the makeup water amount that must be heated. This condensate is of high purity, this will reduce water treatment cost and also reduce energy losses in boiler blow down.

Currently Textile industry two boilers of different capacity, produce different amount of steam. Table below shows the specifications of boilers to be currently work in Rantex.

<table>
<thead>
<tr>
<th>Specification</th>
<th>Boiler 1</th>
<th>Boiler 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Fuel</td>
<td>Gas/wood</td>
<td>Coal</td>
</tr>
<tr>
<td>Steam produced</td>
<td>8tons/hr</td>
<td>9tons/hr</td>
</tr>
<tr>
<td>Condensate Produced</td>
<td>60%</td>
<td>60%</td>
</tr>
<tr>
<td>Pressure</td>
<td>150Psi</td>
<td>150Psi</td>
</tr>
<tr>
<td>Feed Water temperature</td>
<td>60°C</td>
<td>60°C</td>
</tr>
<tr>
<td>Steam temperature</td>
<td>173°C</td>
<td>173°C</td>
</tr>
<tr>
<td>Efficiency</td>
<td>80%</td>
<td>90%</td>
</tr>
<tr>
<td>Blow down system</td>
<td>Automatic</td>
<td>Automatic</td>
</tr>
</tbody>
</table>

Condensate recovery system includes of; condensate recovery vessel, steam traps and de-aeration tanks. When condensate recovery system is implemented then amount of water saved can be calculated as;
Amount of water saved in m³ per year

\[
\text{Amount of water saved} = \frac{(1 - \text{Flash Steam Fraction}) \times \text{Condensate Load in ton/hr} \times \text{Operating Hours}}{\text{Density of Water in ton/m³}}
\]

\[
= \frac{(1 - 0.12) \times (10.2 \text{ ton/hr}) \times 4380 \text{ hr/yr}}{1 \text{ ton/m³}} = 39314 \text{ m³/yr}
\]

Based on data cost analysis of installation of condensate recovery system, it is found that:

<table>
<thead>
<tr>
<th>Annual Amount of water saved</th>
<th>39314 m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual saving for water withdraw</td>
<td>Rs. 2,55,541/-</td>
</tr>
<tr>
<td>Annual saving for raw water treatment</td>
<td>Rs. 2,55,541/-</td>
</tr>
<tr>
<td>Annual saving for wastewater treatment</td>
<td>Rs. 2,47,678/-</td>
</tr>
<tr>
<td>Estimated Installation cost of condensate return system</td>
<td>Rs. 3,67,540/-</td>
</tr>
<tr>
<td>Payback period</td>
<td>5.8 months</td>
</tr>
<tr>
<td>Base Year</td>
<td>2018</td>
</tr>
<tr>
<td>Target Year</td>
<td></td>
</tr>
</tbody>
</table>

3. Water Conservation Plan for Washing Process:

Conventional washing systems are based on a single-flow arrangement and use large amounts of water. Often, products to be rinsed are immersed completely in fresh water, after which the contents of the tank are drained. Alternative configuration that is more efficient and effective is recommended, which is counter current washing system.

In counter-current washing systems, water flows through a series of connected tanks, in opposite direction to the flow of the product to be rinsed. Clean water enters at the final wash box and flows counter to the movement of the fabric through the wash boxes. With this method the least contaminated water from the final wash is reused for the next-to-last wash and so on until the water reaches the first wash stage, where it is finally discharged. There will be only one fresh water feed for entire set of tanks and it is introduced in the last tank. The effluent of one tank will
become feed of preceding tank and so on. So in this way water consumption of washing process will be reduced.

In current situation, large amount of extracted water is used for washing of apparels so if this modified process of washing will be adopted in existing unit then there will be 20-30% reduction in water demand. For one particular recipe, this technique may be adopted to conserve water with little investment for modification in existing setup and immediate payback. It may also require upgrading in the recipes of washing of fabric.

4. Water conservation Plan for Domestic water conservation:

To reduce domestic water consumption of Rantex, it is recommended that tap should be replace by self-closing taps and tap aerators. These facilities will reduce water consumption up to 50%.

   a. Self-closing taps (Percussion taps/push-down taps)

To deliver flow, the user will push down on the tap head. When the user will remove their hand, the pressure generated inside forces the tap up and it will automatically close off the flow (after a delay period set at the time of installation). A delay period of between 15 and 20 seconds is generally suitable for hand washing. Water savings up to 50% can be achieved by this system, but dependent on end flow rate and flow duration. Flow rate of 4-8 liters/min can be achieved by implementation of this facility.

To be most efficient, these taps will need to be well maintained to ensure correct operation. These taps cost around Rs.6000-8000/- per piece depending upon the quality and can reduce water use by over 50%, compared with conventional taps.

   b. Tap aerator

In aerator tap the design of the nozzle mixes air with the water under pressure. When the water exits the nozzle the air expands, increasing the apparent water flow. Water savings will be typically 50% if fitted with a flow
regulator, but dependent on end flow rate. Flow rate can be reduced to between 2 and 8 liters/minute.

Tap aerators are devices that can be retrofitted to existing taps to mix air with the water, producing the same force of flow, and cost as little as 400-500 per unit.

**General Recommendations:**

The following are some recommendation for the conservation of water in a particular industry. Although economic benefits of these recommendations cannot be quantified but these improvements will definitely bring sufficient reduction in amount of water extracted on daily basis. These are;

- A well-designed loss-prevention program should target both real and apparent losses. Real losses are physical losses including leaks, bursts, and overflows. Apparent losses are non-physical losses that include meter inaccuracies and unauthorized consumption, such as theft or illegal use. Leaks in the supply network may be visible or concealed, Leakage reduction through detection and repairs can save lot of water. Use remote sensors for ongoing monitoring of leak detection at source, transmission, and distribution facilities.

- Ensure that meters installed at machines are working properly. Establish protocol for their proper and regular maintenance, repairing and calibration. Evaluate and replace older meters.

- Reducing excessive pressures in the distribution system can save water by reducing stresses that could result in leakage, decreasing quantities of water that are currently leaking, and reducing the amount of flow through fixtures. Pressure reducing valves should be installed at appropriate place.

- If some maintenance issues were observed visually, immediate response should be given for its maintenance to eliminate water losses.

- Flow fixtures could be installed on the taps on the terraces that are used for watering the plants. Flow fixtures typically controls, deliver a precise
volume of water at faucets, showerheads, and hose outlets, typically 5.6 – 8.3 liters per minute, irrespective of varying line pressure. Other technology is aerators which are generally installed or taps fitted with aerators are available, which can cut the water usage of faucets by as much as 40% from 15 liters per minute to 9.4 liters per minute.

Impact of conservation plan on KPIs:

To check the impact of conservation on resources some key performance indicators has been identified. Two types of key performance indicators have been used to assess the performance of water conservation plan. These indicators are operational and financial key performance indicators. These indicators will be used as benchmarks to allow management to track the performance of system and determine the effectiveness of any improvements made to the water system. It shows the impact of recommended conservation plan on KPIs of industry. These results exclude amount of water used for construction purposes.

Impact of Conservation Plan on Key Performance Indicators:

<table>
<thead>
<tr>
<th>KPI</th>
<th>Unit</th>
<th>Now</th>
<th>Then</th>
<th>% Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operational KPIs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ground Water</td>
<td>Mm³/yr</td>
<td>0.548</td>
<td>0.419</td>
<td>23.5</td>
</tr>
<tr>
<td>Domestic Water</td>
<td>Mm³/yr</td>
<td>0.100</td>
<td>0.050</td>
<td>50</td>
</tr>
<tr>
<td>Process Water</td>
<td>Mm³/yr</td>
<td>0.446</td>
<td>0.378</td>
<td>15.2</td>
</tr>
<tr>
<td>Wastewater</td>
<td>Mm³/yr</td>
<td>0.416</td>
<td>0.318</td>
<td>23.5</td>
</tr>
<tr>
<td><strong>Financial KPIs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water Extraction</td>
<td>PKR/yr</td>
<td>3,594,880</td>
<td>2,748,640</td>
<td>-</td>
</tr>
<tr>
<td>Raw Water Treatment</td>
<td>PKR/yr</td>
<td>2,899,000</td>
<td>2,457,000</td>
<td>-</td>
</tr>
<tr>
<td>Waste Water Treatment</td>
<td>PKR/yr</td>
<td>3,120,740</td>
<td>2,385,000</td>
<td>-</td>
</tr>
<tr>
<td>Power Utility</td>
<td>PKR/yr</td>
<td>3,087,000</td>
<td>2,583,000</td>
<td>-</td>
</tr>
</tbody>
</table>
References


I WANT TO DIE WITH MY BLUE JEANS ON.

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