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# Water Consumption Minimizing in Hydrophilic Cotton Manufacturing and Sterile Gauze Industries

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**Abstract** - Among all industries hydrophilic cotton from raw cotton and all type of medical gauze from textile productions have high water consumption. Due to this reason water recycles and reuse in these industries and generally water usage minimization in these units have especial importance. For practical research in this context one of domestic industry has been selected as a case study. Water usage minimization in other industries have been investigated in different countries, but nearly all these researches are related to minimization of water consumption in raw cotton production. Results showed that minimization of water consumption whit recycle and reuse method in these industries are very successful, to the extent of water can be saved about 65 percent after and simple aeration and reservation for 10 hours and recycling in to production recycle. Usually in these industries three types of consumption exist: one for hydrophilic cotton production, next for medical gauze and last for general consumption. In selected industry for medical gauze production and hydrophilic cotton, the amounts of water consumption are 40 lit/kg and 43 lit/kg respectively. And the remaining is about 20 lit/kg for other consumption, such as boiler, chiller, restaurant, personal and ... consumption. Regarding water quality needed for every stage of production.

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**Keywords** : cotton beating, stamping, wastewater recycle, reuse, hydrophilic cotton.

## I. INTRODUCTION

Cotton processing and health cotton production uses large amounts of water and from the various stages of this processing are produced large volumes of wastewater in the end of process, which requires proper treatment before entering the environment. Increasing public concerns about environmental issues and surface and underground water sources and raw water scarcity has led to the closure of some industries [5] [10].

Today, due to shortage of raw water tend to the new sewage treatment methods of these units and

reuse of them has increased and also attempts has been made to substitute water with other chemicals to wash the cotton.

Consumers and manufacturers in order to protect and safeguard the environment and natural resources tend to use natural approaches to sewage treatment and water recovery for urban water use efficiency.

Considering that the hydrophilic and sterile cotton processing wastewater contains high concentrations of COD, BOD and color, efforts to minimize quantity and quality of produced wastewater and finding a suitable treatment method for water recycling and using recycled water in production processes for these industries are very high in importance [4].

Old methods for processing cotton have a large amount of water consumption so the today main challenge is the search of new technologies and changes in production methods.

So that these methods have greater compatibility with the environment, economic issues have also a special priority.

These methods should also have high efficiency as well as less production of wastewater and the quality of output effluent and the recycled water can also compete with the old technology or is even better and all these operations take place with minimal costs [7].

Water consumption in these industries is very high, but yet a comprehensive study on water use minimization techniques has not been done in this area and also on how they can reduce consumption of raw water and how to use water has been retrieved.

Given the importance of these industries, and reduction of water supplies, this research has a great importance.

In the subject of this study has not been conducted no similar work in the inside and outside of the country, but one can point to studies which have addressed this issue in part as follows:

A research about how new and clean cotton clothing worn by the laser beam has been done in England in 2000 by Howard Sutcliffe [1].

Also in the faculty of Chemical Engineering - University of Guilan, Rasht, a research on using nanotechnology as the photo catalytic which is used to

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clean cotton that has been conducted by Mr. Falah Moafi.

A research by Mr. Khezri and colleagues related to evaluation of the quality of wastewater treatment of cotton processing and offering optimized method was carried out in 1390 in Tehran [7].

And another investigation in relation to sewage treatment of hydrophilic cotton and evaluation and providing the optimal method by Mr. Khezri and colleagues has been conducted in 1390 in Tehran [10].

## II. MATERIALS AND METHODS

The aim of this study is to investigate the minimization of water use in the industry of hydrophilic cotton processing and production of sterile and hygienic gauze. To achieve this goal one of the domestic industries has been selected as a case study [3].

This plant can be selected as an indicator and sample of the total factories in domestic and even abroad regions. The work method is a field study which starts with the full identification of cotton and gauze production process. And then the water needs of each of the processing units and quality of these waters will be found. Finally the water consumed in each line having the characteristics of raw water in another

process is consumed in that process and if these conditions are not satisfied collecting them in a pond and aeration and also giving the required time, it acquires the necessary conditions for some processes.

Thus, the research method is a field and analytical method. Certain material has not been used in this study, except chemical materials in experiments related to water which include TSS, COD and BOD. Required equipments include thermometers and digital pH meters [2] [3].

## III. RESULTS

Consuming water in plants of hydrophilic cotton and sterile gauze production can be divided into three parts:

- 1- consuming water in hydrophilic cotton
- 2- water used in the production of sterile gauze
- 3- consuming water in staff costs and other expenses

In accordance with the measurements total water consumption of different months is shown in Figure 1.

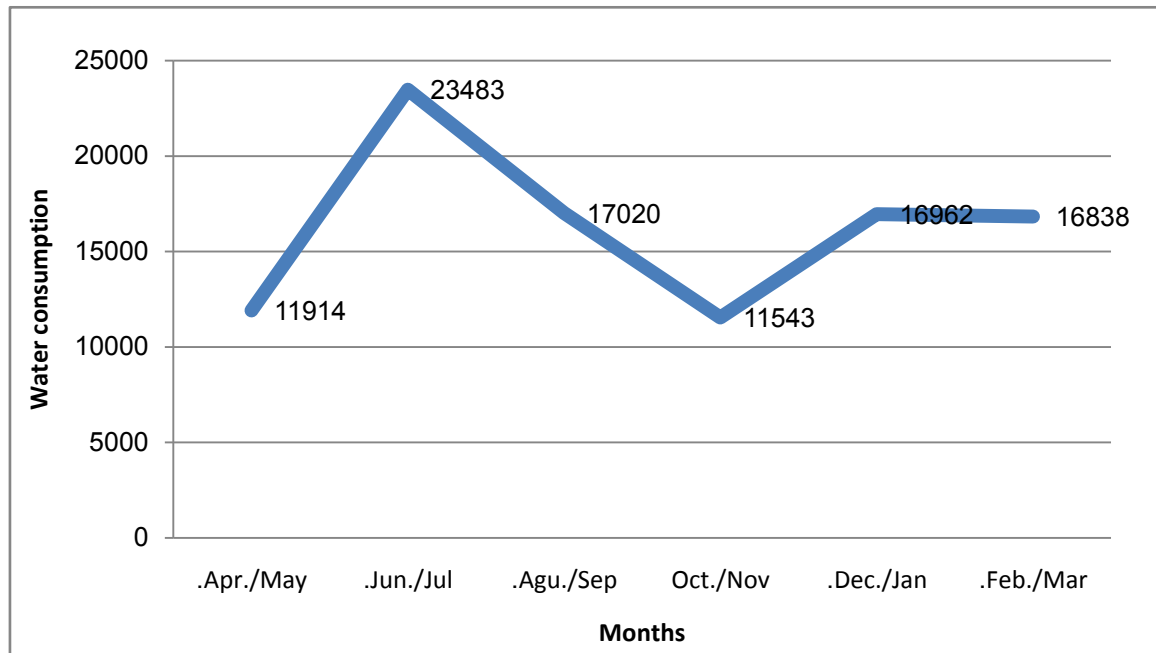


Figure 1 : Total water consumption of different months in term of (m<sup>3</sup>/year)

Figure 2 is a breakdown of consumption

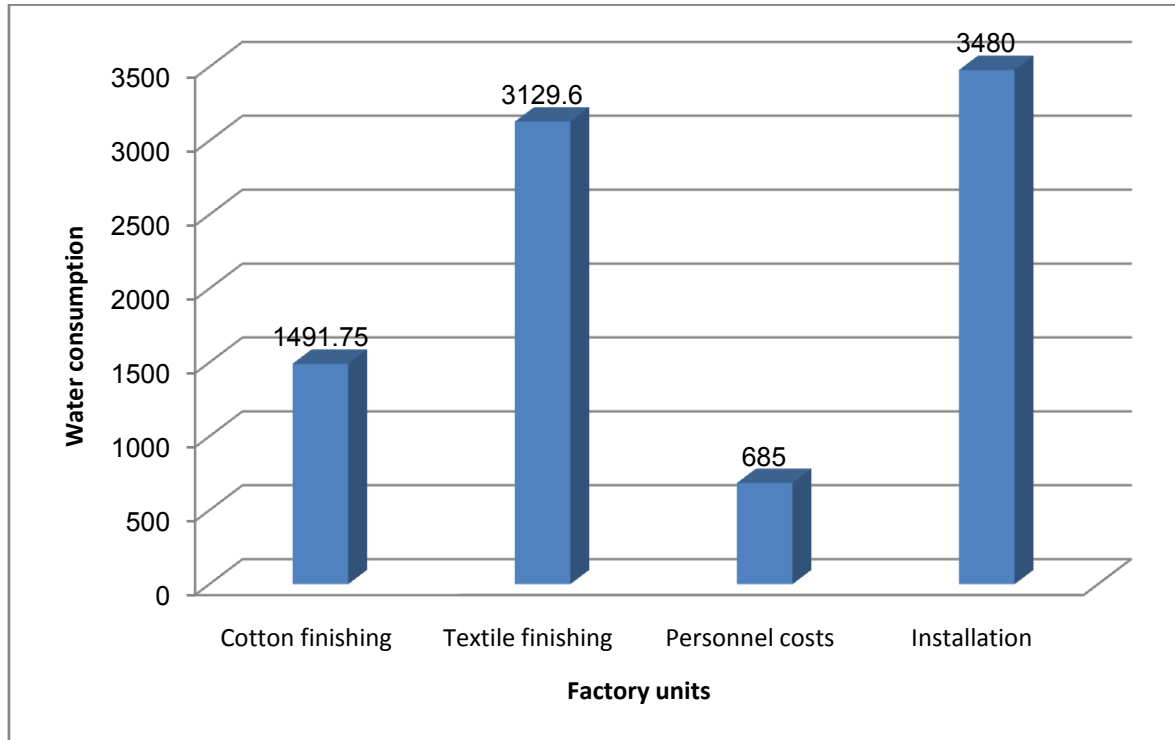


Figure 2 : Total amount of municipal water consumption in factory units in month in term of (m<sup>3</sup>)

On average 43 liters of water per one kg of hydrophilic cotton and 40 liters of water per one kg of sterile gauze is consumed, but this amount is the raw water intake after following the minimization issues which will be explained in detailed.

The schematic diagram of hydrophilic cotton production is as diagram 3.

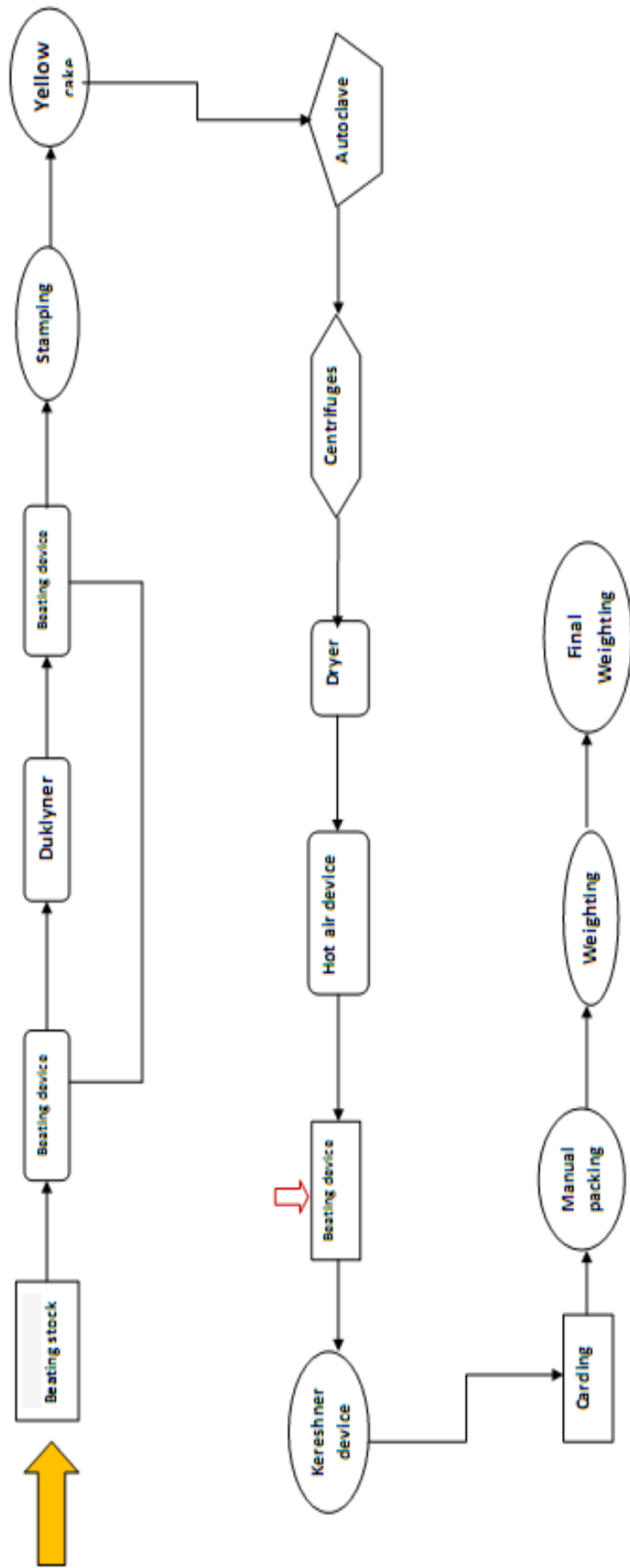


Figure 3 : Diagram of hydrophilic cotton production

Water consumption in the processing and operational units is mainly related to stamping and autoclave. The amount of water consumption in the stamping unit is 6 cubic meters per every 120 kg mould. Also the water consumption of this phase is the most of all steps and is almost three times the autoclave phase.

In Autoclave unit per 360 kg (three 120 kg mould) Cotton, 12 cubic meters of water is consumed. The completion process of sterile is shown in Figure 4.

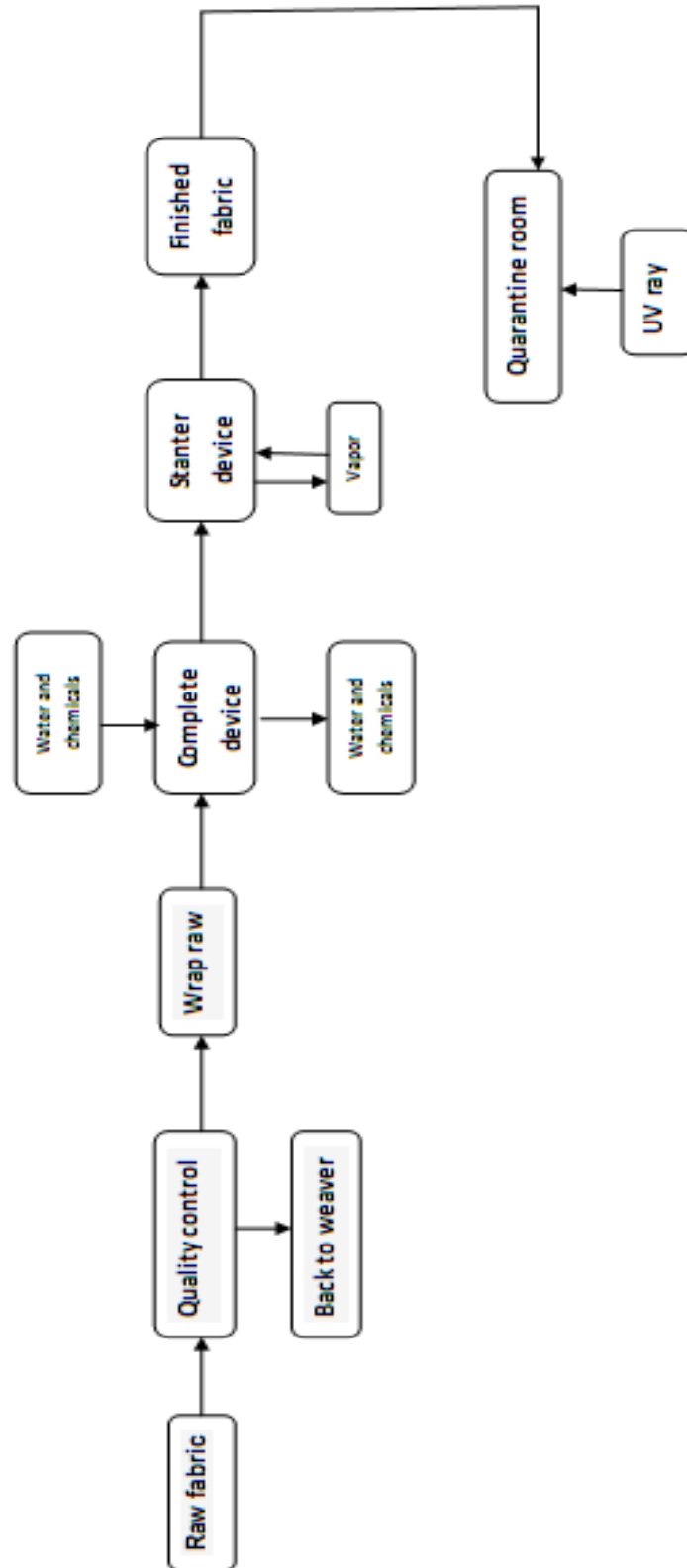


Figure 4 : Completion process of sterile gauze

Sterile consuming water is required for the completion of washing, whitener, reduce fat and eliminate microbial contamination that can be done in completing this work. In this stage a large amount of raw water is used for washing. Per kilogram of gas, 40 liters of raw water are consumed.

In the process of cotton production in some parts in consequence of the water and chemicals use, waste water is produced.

In Figure 5 is shown the different units of hydrophilic cotton processing in which wastewater is produced.

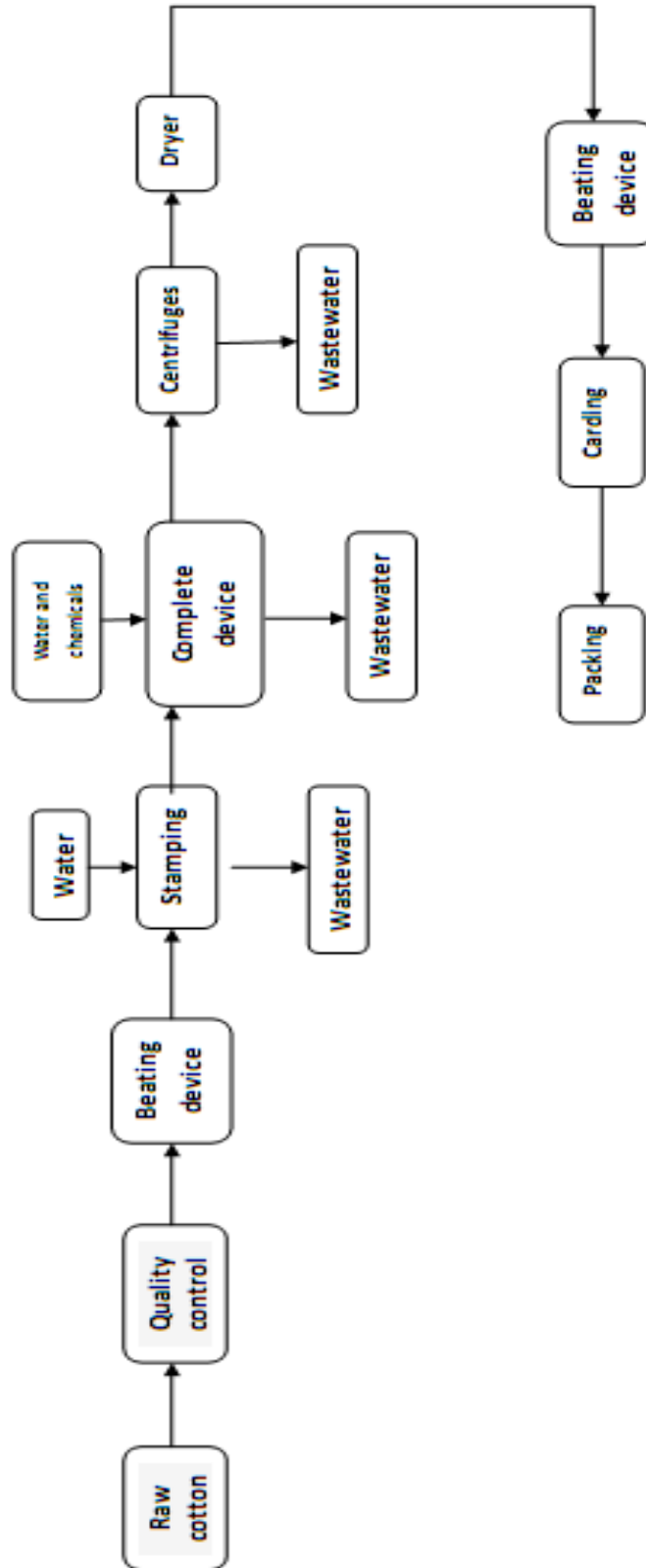


Figure 5 : Wastewater producing in hydrophilic cotton process

In the stamping units per a 120 kg mould of the cotton, 6 cubic meters of wastewater is produced. During a working day, as a result of using this device is produced 48 cubic meters of sewage water.

Then, in an autoclave or completion system the water and chemicals are used for washing, bleaching and fat removing of the cotton. In this stage because of caustic soda, detergents, hydrogen peroxide and acetic acid there is a considerable amount of waste. The

amount of waste produced in an autoclave for 3 hours at per 120 kg batch is equal to 12 cubic meters of sewage. The total amount of wastewater generated in this sector at 24 hours (a working day), the value is estimated at 96 cubic meters.

Finally, in the hydrophilic cotton processing process, some waste is produced in centrifuges. In Table 1, the amount of waste produced in the studied factory is shown in terms of cubic meters a day.

Table 1 : The amount of waste produced in the hydrophilic cotton processing

Name of units	Autoclave	Stamping	Centrifuges
The amount of waste produced(m <sup>3</sup> /day)	80	48	16

Strategies for reducing urban water consumption in hydrophilic cotton and sterile processing units:

In the stamping unit due to its specific mechanisms, the hammers which act as a hammer blow cause to soak the cotton in the water and grind the two together. At last they convert into the mould of the so-called "yellow cake". The weight of this format is 120 kg.

As a result, water can be provided from the retrieved water from the processing and manufacturing stages.

In the Autoclaving or cooking pot, six main functions are accomplished:

- 1 - Cooking
- 2 - bleaching
- 3 - neutralization
- 4 - three-stage rinses

For saving and reduction and minimizing the consumption of raw water one can use recycled water in three parts of autoclave machine and raw water in three parts of rinse in the autoclave device.

Therefore for every 360 kg of the hydrophilic cotton is harvested, 6 cubic meters of recycled water and 6 cubic meters of raw water.

Due to differences in water quality requirements for processed cotton in various parts of it, required water of some of the units can be supplied by the recycled water and raw water can be provided for other units.

In Figure 6 is shown the percentage of water use in expressed process after minimization strategies and use of recycled water, and ultimately reduce the consumption of raw water.

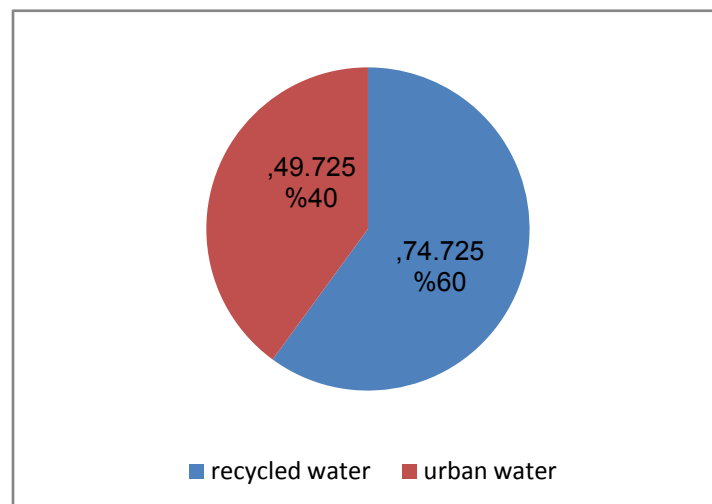


Figure 6 : The percentage of urban and recycled water use in cotton processing in term of (m<sup>3</sup>/day)

60 percent of water used in the completion of hydrophilic cotton is provided by the recycled water and the remainder, 40%, is supplied by the raw water.

Minimization in the processing unit and the production of sterile and sanitary gauze is as follows:

To wash fabrics with chemicals, due to the lack of importance of water quality, recycled waters from the production and processing phases in different stages can be used and raw water can be useful for rinsing and dry-cleaning cloth is also applicable.



According to Figure 7 a significant savings have been achieved in the raw water intake in washing and completion of sterile and hygienic gauze.

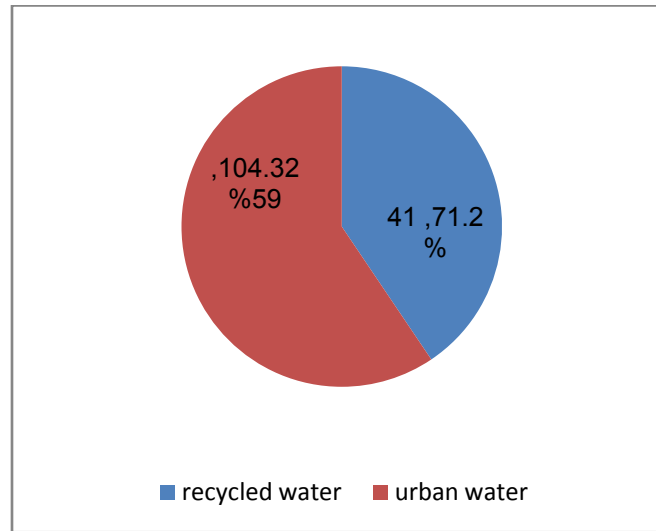


Figure 7 : The percentage of urban and recycled water use in completion processing in term of (m³/day)

A large amount of raw water, 59%, is consumed to finish fabric which is considerable compared with respect to recycled consumption water with a rate of 41 percent.

But turning back the retrieved waters to the production line and completion of sterile gauze, significant savings at this stage and the amount of raw water have been achieved

By applying all of these mechanisms still some waste is generated that is necessary to think of a solution for its treatment. Currently these wastewaters enter the wastewater treatment site which its treatment stages are shown in Figure 8.

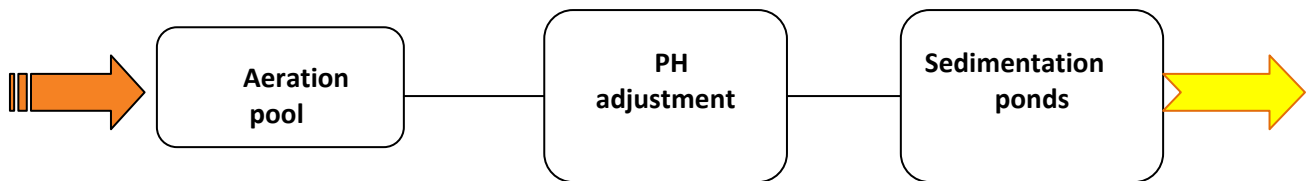


Figure 8 : Wastewater treatment site

Sampling of the input and output sectors of this treatment site that has been done in several cases, on average leads to the summarized results of Table 2 and 3.

Table 2 : Sampling of the input sector of this treatment site

Physical exam	Unit	Value
Temperature	C°	70
Chemical exam	Unit	Value
COD	(Mg/l)	2600
BOD <sub>5</sub>	(Mg/l)	980
TSS	(Mg/l)	320
pH	-	12

*Table 3* : Sampling of the output sector of this treatment site

Physical exam	Unit	Value
Temperature	C°	45
Chemical exam	Unit	Value
COD	(Mg/l)	2500
BOD <sub>5</sub>	(Mg/l)	-
TSS	(Mg/l)	120
pH	-	0

As can be seen, the current treatment system is not exactly fulfilling EPA standards and cannot be disposed to be receptive sources.

#### IV. CONCLUSION

Looking at the cases of consumption in the processing units of hydrophilic cotton and production of sterile and sanitary gauze one can conclude that the most consumption is in the completion unit of fabric and the autoclave and stamping units [8] [11].

Fortunately stamping unit can consume significant amounts of water to reach the playoffs again. With the use of this action 43 liters of raw water consumption is saved per a kilogram of hydrophilic cotton.

In the autoclave unit due to the sensitivity of the health care waste water using has no place at all stages. But it is possible to use recycled water in some sections of this unit such as washing units and one can also prevent the water loss.

In autoclave unit due to lack automatic closing system of water, mostly the water is over flown and water is wasted. Therefore, it is also possible in this unit to minimize the up or down of the water and its loss by installing level control sensors [6] [10].

In the completion unit of the fabric can be used modern methods such as dry cleaning cloth and its preparation to produce sterile gauze bandages. Since at this moment 40 liters of water is used per kg of fabric, it is possible to reduce the water consumption at least 70 – 80 percent. Thus the water consumption falls from 40 liters to 12 liters.

Research suggests that dry cleaning of cotton is economically affordable, aside from that, there is no water in some areas to be used in cotton processing. And thus the application of innovative technologies not only helps to protect water resources from industrial units but also prevents industrial units from being shut down [2] [5].

Future research in this field can be focused on sewage treatment methods of these units and /or use of hybrid systems in refining or fabric washing methods [12].

Because research has shown that technology-based membrane systems are the best methods that can be replaced by the old methods.

In addition, hybrid treatment techniques, including absorption and absorption by a nano-filtration can also be effective to improve the quality of produced effluent. Moreover, additional treatments include ion exchange systems can apply the effluent such that it has the ability to returning back to the production line and the use of recycled water from the processing steps [1] [9].

Therefore, the water consumption in the production line is similar to a closed cycle and water usage is reduced to its minimum. Of course there are still more strategies, such as modern cotton-processing methods includes dry cleaning of remaining ingredients which can be done to reach to a greater amount of water saving.

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