

Importance of water & wastewater reuse in different industries as an effective solution in dehydration crisis

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Abstract

Water savings can be achieved in different industries through a combination of changing behavior, modifying water saving equipment to reduce overall water consumption and increase internal reuse. Treating wastewater for reuse has become an accepted and reliable technical solution to save water. In fact, water recycling and waste water reuse have proven to be effective in creating reliable water supply. Attempts to waste water treatment such as urban, domestic, industrial and agricultural waste water have been reported by physical and chemical treatment process. Different physical steps such as settling basin, oil skimmer, clarifiers, self-cleaning filters, activated carbon filters, filter press, flocculators, thickeners and membrane technologies are suggested according to the quality of waste water. De-mulsifier, poly electrolytes and disinfections are the common chemical treatment. The objective of this paper is to present possibilities of waste water reuse and water usage reduction and consequences of this operation in steel companies. The waste water in steel companies could be treated, cooled and reused in

industry. Higher treatment quality could increase the number of water cycle count and save water.

Key words: Waste water, Water, Reuse, Treatment, Steel industries, Water consumption

1. Introduction

Water plays the key role in steel industry. For this reason, it has historically presented challenges for effective water treatment as a high water user. The steel industry uses large quantities of water, nevertheless a very small amount is consumed, as most water is reused or returned to the source. Water is used not only in cooling operations, but also for other processes, such as descaling and dust scrubbing [1-3]. The waste water produced in this factory contains different pollutants such as oil and grease, total suspended solids (TSS), microbial pollution, so the main emphasis should be on removing these pollutions. According to high produced heat in this industry, different kind of cooling towers (direct contact, non-contact cooling) exist in steel factories [4-6]. A common goal is to reuse as much water as possible within the various water systems. It is noticeable that most of the consumed water in steel companies is evaporated and around 90% of the water is discharged after cleaning and cooling [7]. In order to keep the quality of water and also to prevent destructive phenomenon such as scaling, corrosion and biological growth, chemical water treatment the key factor in this field. High concentrations of sulphate and chloride, high hardness, microbial pollution, high TSS, high chemical oxygen demand (COD) and biochemical oxygen demand (BOD), and turbidity should be removed by proper methods such as reverse osmosis, ultrafiltration and disinfection. So, in most of the steel companies reverse osmosis system

exists to produce desalinated and pure water [8-12]. The make-up water in cooling towers is usually provided by reverse osmosis to keep proper balance among makeup, evaporated and blow down.

2. Steps of waste water treatment

The out let waste water of factory is loaded in a concrete septic tank. Settling basin is designed for sedimentation of large particles suspended solid and also for floating oil and grease. Oil skimmers collect and remove the oil from surface of waste water exit from the septic tank by special pumps. According to the type of the oil (dissolved and non-dissolved) using chemical compound demulsifier is usually suggested to remove dissolve oil. Then, clarifying space could separate primitive treated wastewater and pump them to automated self-cleaning screen filters. Many municipal and industrial wastewater treatment plants use these filters to prepare secondary effluent for reuse in cooling, irrigation and aquifer recharge systems. Theses filters are used for removing remained suspended solids and turbidity with high reliability. For the samples with high COD, smell and color usually use of activated carbon filter is suggested. The outlet of screen filters then entrance to cooling tower (direct circuit) to reduce temperature. It is known that filters such as sand filters, dual media filters, activated carbon filters and self-cleaning filters have to back wash in-order to clean the media or screen surface .In this mode, water is passed through the filter in a reverse direction from normal flow to remove the solids from the media or element and expel them from the filter body. The produced waste water in backwashing mode of filters could be treated. The out let backwash water transferred to the thickeners and after combination with poly electrolyte (added by flocculator), and elimination of solid particles

entrance to cooling tower. Selection of type and concentration of poly electrolyte was performed by jar test. Figures 1 and 2 show the diagram of cooling tower operation (indirect circuit) and waste water treatment coupled with direct circuit cooling tower respectively.

3. Chemical water treatment

Industrial use of water needs essential physical and chemical water treatment to reduce water consumption and increase cycle of concentration (COC). As mentioned before, with no proper water treatment, destructive phenomenon such as scaling, corrosion and biological growth (biofilm formation) cause expensive and irreparable damages. The first step for chemical dosing suggestion is make-up water and circulatory water chemical analysis. Quality of feed water, manufacture-recommended quality requirements for the cooling tower and equipment, chemistry of water, regulatory requirements for discharge, whether or not blow down will be treated for reuse in the cooling tower and type of heat exchanger are other major parameters that should be investigated. Water chemical analysis is the best alarm for determination of water quality. Each parameter shows the possibility of problem which should be treated. For example: alkalinity dedicates potential of calcium carbonate scale, chloride and sulphate have high potential to be corrosive to metals, iron has high potential in fouling and combination with phosphate, hardness and silica cause scale formation, total dissolved solids (TDS) can contribute to scaling and corrosion, TSS causes scaling, corrosion and biofilms formation and organic matter can promote microorganism growth, fouling and corrosion. There are economic solutions which could improve the water quality. Softening by lime and soda ash, coagulation and flocculation by inexpensive compounds are the solution that could be

recognized in water treatment by chemical compounds. As mentioned before, cooling towers can also grow harmful bacteria, such as legionella, which is naturally present in surface water. Depending on the microbiological contaminants present, certain membranes are efficient, as well as bio-dispersants and oxidizing and non-oxidizing biocides. In addition to water chemical analysis there are some calculating indexes that can help to recognize the character of water. Parameters such as lengelier saturation index (LSI), ryznar stability index (RSI), puckorius scaling index (PSI) can be calculated according to the water analysis report. These indexes can predict the possible characteristic of water (water corrosive or scaling potential) [14]. The parameters needed for these calculations are pH, alkalinity, calcium hardness, temperature, total dissolved solids.

3.1. Chemical water treatment in indirect circuit cooling tower

Indirect circuit cooling tower (Figure 1), is responsible to cool water which is non-contact to equipment. In this cooling tower, make-up water is provided by reverse osmosis system presents in the site. The loss of water happens by evaporation and blow down so the chemical dosage is performed on blow down basis. It should be noticed that, the kind of alloys in factory equipment is very important. In Fact, it should be clear that what are the alloys and metals that cooled water has to be in contact. Indirect cooling tower outlet contacts to stainless steel and copper alloys so the special chemical (Azole compounds) should be used to prevent copper alloy corrosion. The chemicals suggested here is zinc-phosphonate / dispersant and azole. Biocides (Oxidant and Non-oxidant) based on chlorine and isothiazoline (Or glutaraldehyde) are used for disinfections and prevent biological growth. Oxidant biocide (usually

hypochlorite) injection is performed continuously and non-oxidant biocide injection is performed by weekly shocks.

3.2. Chemical water treatment in direct circuit cooling tower

Direct circuit cooling tower (Figure 2), is responsible to cool water which contact to equipment. In this cooling tower, make-up water is provided by reverse osmosis system presents in the site. The loss of water happens by evaporation and blow down so the chemical dosage is performed on blow down basis as mentioned in indirect cooling towers. Direct cooling tower outlet contacts to stainless steel alloys. The chemicals suggested here is zinc-phosphonate / dispersant, Biocides (Oxidant and Non-oxidant) based on chlorine and isothiazoline (Or glutaraldehyde) and bio-dispersant. Oxidant biocide (usually hypochlorite) injection is performed continuously and non-oxidant biocide injection is performed by weekly shocks. Here, according to the high pollution and high risk of biological growth bio-dispersant is used to prevent biological pollution and biofilm formation. The applicability of suggested chemical is searchable by different microbial test kits and measuring the injected chemical residual. Calculation of corrosion rate in mpy (mils per year) by application of corrosion coupons is another common method to predict the status of alloys and equipment in the factory.

4. Conclusion

To assess the reliability of water & waste water treatment facility, several aspects of treatment must be considered. Recently, due to the high risk of dehydration,

waste water reuse and optimizing water sources use are too important. It is known that different kind of waste water such as urban, domestic, industrial, agricultural,... could be treated and reused by using proper methods and process. Most of the industrial factories especially those located in desert regions are concerned about this problem. Reusing waste water in such factories is the only solution to save water. Some practical example in Iran and other countries show that this solution could be performed successfully by precise selection of physical and chemical treatment methods.

Figure 1

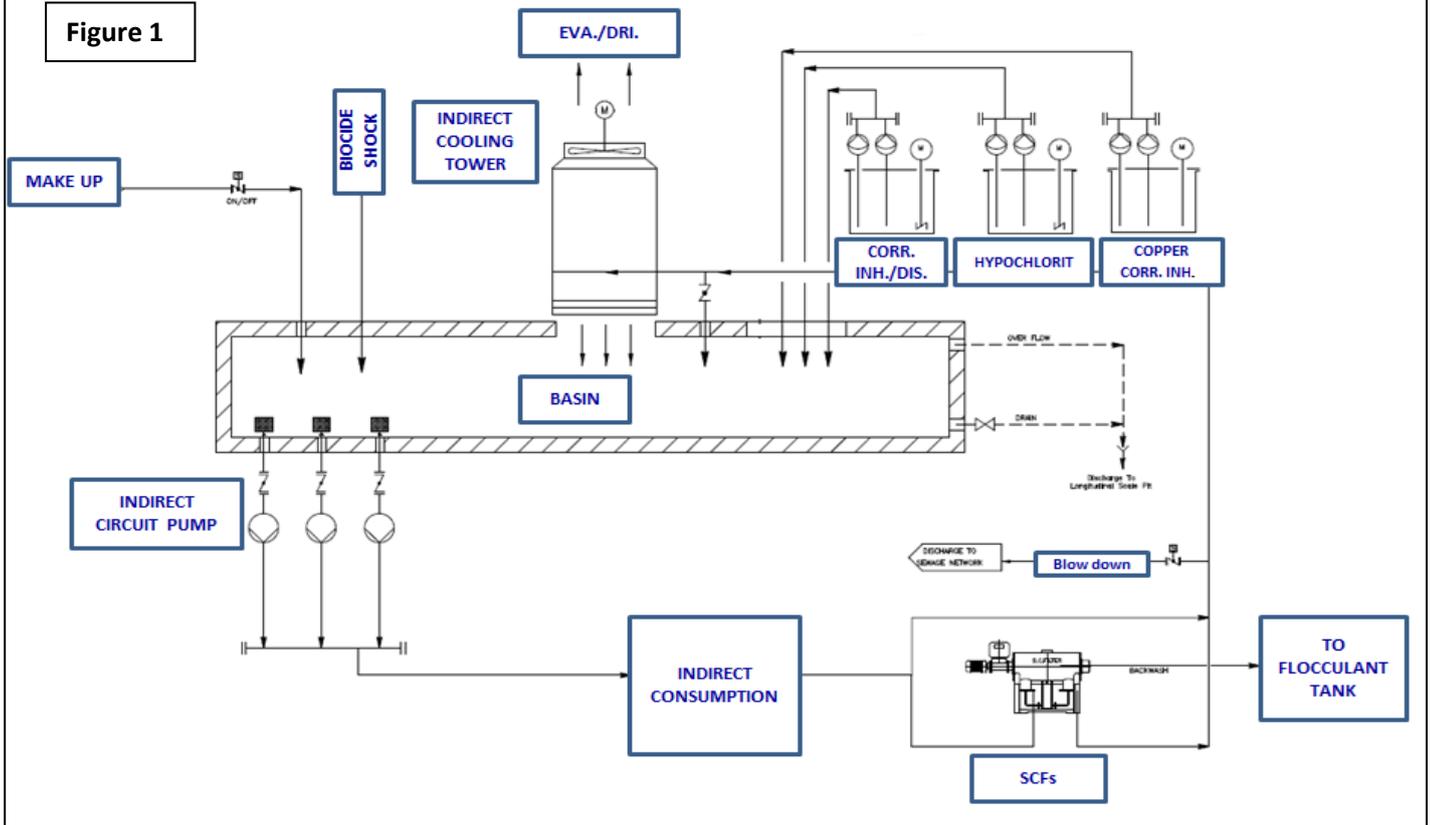
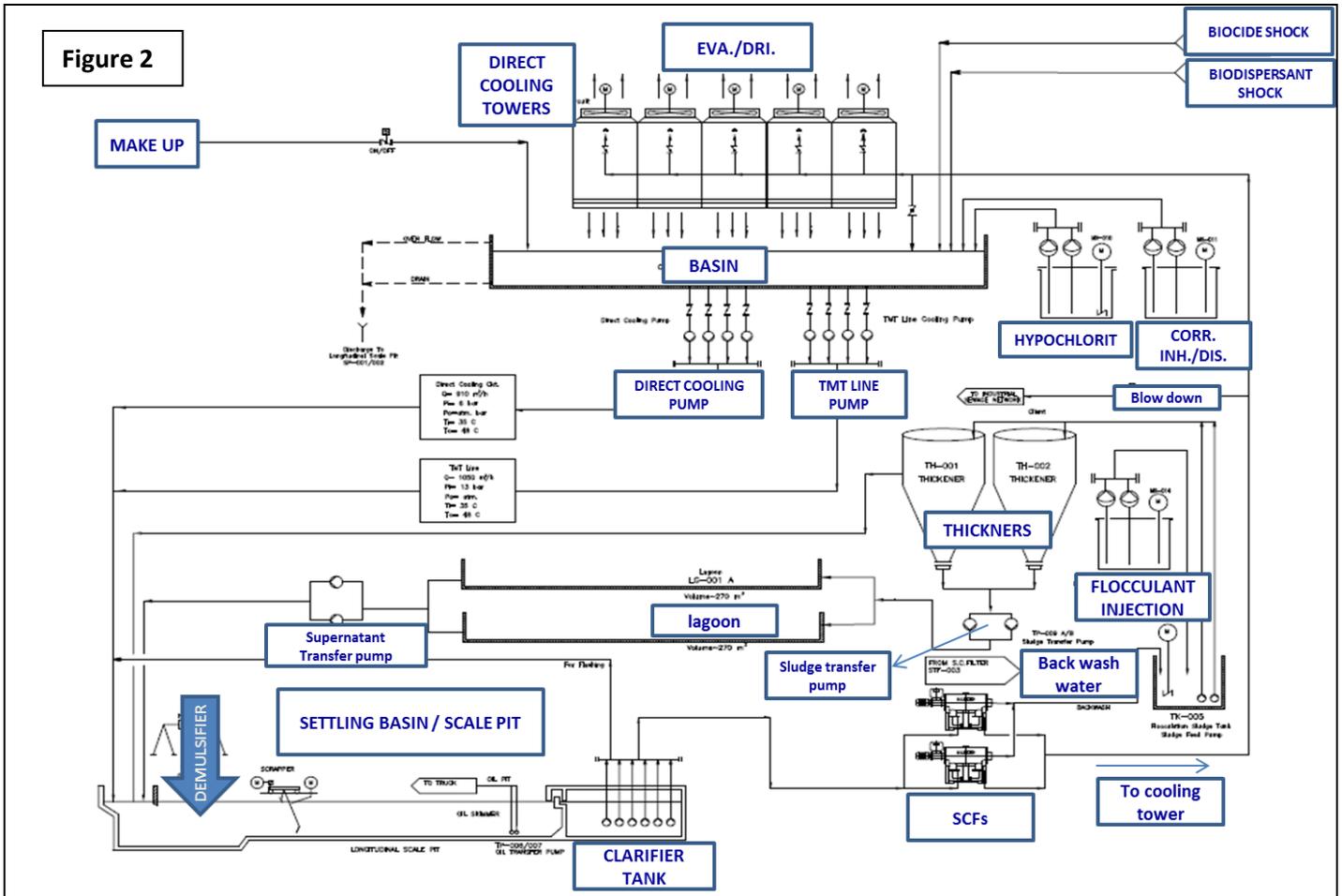


Figure 2



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