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Caustic Soda Injection in Potablization Process

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Abstract

Shoaibah Independent Water & Power Project (SIWPP) is the largest private sector Desalination Plant in the Kingdom of Saudi Arabia situated at about 110 Km south of port city Jeddah on the Red Sea coast. It consists of 12 Multistage Flash (MSF) Desalination evaporators having a net distillate production capacity of 880,000 m^3/day and 3 non-condensing type of turbines with a net Power generation capacity of 900 MW. M/s Doosan Heavy Industries & Construction Co., are the principal manufacturer of MSF distillers. The Project Company is Shoaibah Water & Electricity Co. (SWEC), the Project Developers are Saudi Malaysian Consortium and the Operators are Saudi Malaysian Operation & Maintenance Company (SAMAOMCO), whereas the First National Operation Company (NOMAC), an international joint venture, is practically operating this gigantic facility as sub-contractors. The Plant started its commercial operation since 14th January, 2010.

The following paper is an overview, which basically describes the philosophy of post-treatment of the desalinated water (distillate) produced from MSF distillers. This process is commonly known as Potablization or Re-Mineralization or Re-carbonation. The basic objectives of Potablization, chemistry involved in this process and different methods of Re-mineralization have been presented in this paper. Also, an assessment has been made to investigate whether there is any scope to minimize and/or totally eliminate the Caustic Soda (NaOH) injection from the Potablization process at SIWPP. All possible concerns in this regard, which one might think of, have been evaluated and addressed in this paper.

Keywords: *Potablization, Distillate, Multistage Flash, Passivation, Non-Aggressive, Langelier's Saturation Index.*

1. Discussion

1.1 Objectives of Potablization Process

(i) The aim of Potablization process is to increase the Calcium Hardness and Alkalinity of the product water to a desirable level and also to adjust the pH so that the treated water becomes buffered and non-aggressive with a slightly positive Saturation Index; thus, forming a thin protective layer of Calcium Carbonate ($CaCO_3$) in the water transportation/distribution pipelines for protecting the system from internal corrosion. The main phenomenon occurring during this Re-carbonation treatment is an increase of Ca^{++} and HCO_3^- ions in the distilled water, and

(ii) Addition of Re-mineralized salts by dissolving limestone and chemicals in distilled water to improve the palatability of potable water and meet the desirable drinking water standards.

1.2 Some Common Practices of Potablization

1.2.1 Limestone Filters Process

This type of process is currently utilized at Az-zour, Al-Taweelah, Umm Al-Nar, Sohar, Ras Laffan, Sabiya and Shoaibah IWPP Desalination Plants. The alkaline Hardness required in the drinking water is obtained from the reaction of dissolved Carbon Dioxide (CO_2) with Calcium Carbonate ($CaCO_3$) contained in the limestone following a chemical reaction:

$$CaCO_3 + CO_2 + H_2O \rightarrow Ca(HCO_3)_2$$

This process produces treated water with increased Calcium Hardness and Alkalinity contents having actual system pH equal to theoretical saturation pH (represented as pHs). The NaOH or Sodium Carbonate (Na_2CO_3) dosing is required in this method at the limestone filter outlet to neutralize any residual CO_2 and attain the pH essential for achieving the desired Langelier's Saturation Index (LSI), which is a calculated number widely used to predict the Calcium Carbonate stability of water; i.e., whether the water will precipitate, dissolve or remain in equilibrium with Calcium

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