Operation and Maintenance of Electrochlorination Plant

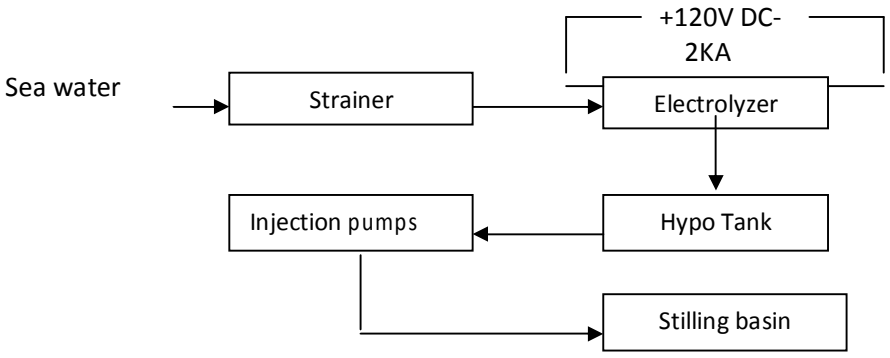
Introduction

Sodium Hypochlorite is a powerful biocide and oxidizing agent that has been widely used in seawater cooling system to avoid the biofouling by marine organisms such as barnacles, mollusca, byrozoa, and sponges. They lodge and grow at intake structures, bar racks and screens, tunnel walls and condenser pipes. It results in reduced seawater flow rate and heat exchanger capability, corrosion of condenser pipes and metallic surfaces, affecting Debris Filters and subsequently affecting condenser vacuum.

The continuous injection of Sodium Hypochlorite solution at sea water intake at a particular designed rate of flow with the concentration of 2 to 3 ppm will ensure the complete control of bio fouling.

Electrochlorination

The simplified flow chart below shows the process of Sodium Hypochlorite generation from seawater and it should be used as guide to the following description which is very general and common arrangement in any power plant where sea water is used for cooling system.



Seawater system

Seawater from the cooling water intake chambers is delivered to the chlorination plant by seawater pumps installed in the cooling water pump building. All the solid particles in seawater are filtered before it passes through to the electrolyzers. For this purpose two automatic backwash strainers with filter elements of size 0.5 mm are installed at up stream of generator.

The cleaning of filter element is controlled by a differential filter pressure switch or timer.

Part of the filtered seawater flow is delivered to the suction header of the hypochlorite injection pumps to maintain a constant injection flow rate and consequently a constant velocity through the injection pipe during the continuous hypochlorite dosage.

Generation of Sodium Hypochlorite

The generation of available chlorine from seawater, as diluted hypochlorite solution is carried out by using Electrolyser system. For each system, no. of electrolyzers are installed depending upon the capacity and each electrolyzer consists of electrolytic cells. The electrolytic cells are bipolar in design, means that the anodes of every cell are directly connected to the cathodes of the next cell. There are other designs also.

Each unit is capable to produce Hypochlorite with available Chlorine at its rated particular capacity. The available Chlorine concentration in hypochlorite solution produced is at particular ppm for example 1000 ppm.

The chemistry of the process is based on the electrolysis of Sodium Chloride in seawater as it flows in a cell equipped with electrodes energized with direct current. The overall chemical reaction can be expressed as below:

$2NaOH + Cl2 \rightarrow NaClO + NaCl + H2O$

The other reaction takes place during electrolysis is precipitation of Magnesium Hydroxide and Calcium Carbonate, which will be removed by seawater stream. However this deposit tends to stick at the cathode plates. These deposits can be removed by dissolving them in a diluted solution of hydrochloric acid, which is circulated through the electrolyzer module.

Hypochlorite degassing and distribution

Seawater containing the sodium hypochlorite and hydrogen gas is transferred to hypochlorite storage tank. The hydrogen gas is separated from the liquid at upper part of the tank. Air is blown into the tank to keep the Hydrogen concentration less than 1% and to release it to atmosphere.

No. of identical chlorination pumps are provided for continuous dosing and for shock dosing of the hypochlorite solution.

The hypochlorite solution is dosed at stilling basin or along the sea water pipe lines at designed locations for full protection of seawater circuit. The continuous dosing flow rate and shock dosing flow rate is decided according to the design and it varies from plant to plant.(For example, continuous dosing of 125 to 132 m3/hr and for once in every 8 hours shock dosing for 10 minutes at a rate to 240 m3/hr.)

Electrochlorination Plant in a Power Plant

If we enter any Power Plant (where sea water is used for cooling and Electrochlorination process is used to produce Hypochlorite), Electrochlorination Plant is always located at the tail end of the plant.

The energy and focus of the O&M team of the plant will always be on the main plant.

In some power plants the building of the Electrochlorination Plant itself will be in a pathetic condition.

Expectation and approach of Power Plant Operators

The O&M team of personnel expect the Electrochlorination Plant to run without or with minimum care. With such expectation in mind they ensure that it just runs and produces required quantity of Hypochlorite. They do not spend even little time to analyse its trend of efficiency, its power consumption etc., like they do for the turbines, generators and big pumps and motors like feed water pumps and motors.

Even when such proposal is brought up by any one in a power plant then the question of who has to do arises, i.e whether Electrical Maintenance, Mechanical Maintenance, Operation or Chemistry and Environment department?

With no clarity on the role, the issue does not take off further at all.

OEM's approach and attitude

Once an Electrochlorination Plant is handed over after commissioning, OEM's do not care much about the plant until when the plant reaches the state of replacement of Electrolyser after its designed life time of Five (5) years or earlier due to premature failure.

OEM's also do not possess the experience or data about day to day problems and issues arising out of Electrochlorination Plant.

They do not keep and maintain any databank of problems about the Electrolysers they supply in plants around the world.

Performance of the system

Performance of the Electrolysers which is the heart of Electrochlorination Plant depends mainly on Two major factors as given below:

- Sea water quality.
- Maintenance Practice.

With respect to the performance of the system, over its designed life time, the deterioration is ascertained by monitoring the following factors:

- Trend of voltage drop.
- Chlorine production.

Monitoring and analysis

Among the two, Sea Water quality can not be controlled except some good filtration. There are other pollutants in the form of chemicals, minerals etc., entering into the sea water which will enter Electrolyser.

The two pictures taken in a Power Plant clearly shows how bad a sea water quality can be affected from a near by plant.

With such a bad sea water quality we can not expect Electrolyser to last even half of its designed life time of 5 years.

Nearing the end of expected life time of the electrolyser , the deterioration will be a sudden drop which can be known by not able to increase the current to the rated value at the rated voltage. When the electrode or the coating over its anode plates starts deteriorating, the voltage drop across the electrolyser starts increasing, as a result the current can not be increased to its rated value. Thus, the end result is decay in chlorine production. Just a picture below shows, how a decay in chlorine production will lead to marine growth in bar screen which will eventually lead to blockage and drop in sea water intake flow into cooling water system etc.,etc.,

However, by closely monitoring and analyzing the Electrolyser operational data, we can arrive at a suitable maintenance practice and achieve the following:

- Prevention of sudden failure of Electrolyser.
- Electrolyser to reach its designed life time.
- Possible operation of Electrolyser beyond its life time.

We, the team of **VJIKKS ENGG POWER (M) SDN BHD**, having experienced in Operation and Maintenance of various manufacturer's Electrolysers, can provide our services to achieve the best out of your Electrochlorination Plant with a fraction of a new Electrolyser's cost.

We can be contacted and discussed to hire our expertise to help the Power Plant Operators to achieve the highest possible availability of Electro chlorination Plant.