Project Title: Investigation and feasibility study of water disinfection with multi-oxidant solution and case study of construction of the relevant production unit in Tarasht power plant

Department:	Power plant chemistry upgrade and development plan (water, fuel and oil)	***Employer:***	Niroo Research Institute (NRI)
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Disinfection, Multioxidant, Tarasht power plant, Water, Feasibility study, Unit construction

Project Necessity:

Due to the high cost of H2O2, in-situ technologies will be able to significantly reduce the costs of the pollutant decomposition process. Glucose oxidase is the most well-known biocatalyst for the in situ production of H2O2 and di-glucose oxidation, the reaction of which is as follows:

$$C_6H_{12}O_6 + H_2O + O_2 \xrightarrow{GOX} C_6H_{12}O_7 + H_2O_2$$

Glucose oxidase is active in the temperature range of 20 ° C to 50 ° C and in the pH range, 4 to 7, and its isoelectric point occurs at pH = 4.2. Accumulation of H2O2 reduces glucose oxidase activity, but by consuming it instead, it prevents the reduction of enzymatic activity.

The enzyme glucose oxidase ensures the production of hydrogen peroxide under normal conditions and at low cost. In addition, it prevents the potential dangers of storage, transport and handling of this powerful oxidizer (H2O2). In addition, glucose oxidase is a biomaterial and environmentally friendly.

Multioxidant production is done on site using electrolysis of water and salt solution. The multioxidant produced is a combination of several effective oxidants including ozone, oxygenated water, chlorine dioxide, sodium hypochlorite, hypochlorous acid, dissolved chlorine gas and dissolved oxygen.

Investigation and feasibility study of water disinfection with multioxidant solution and case study of construction of the relevant production unit in Tarasht power plant are very effective in the decision of power plant officials and the results of this project pave the way for the necessary policies in this area.

Project Goals:

The aim of this project is to determine the optimal amount of glucose oxidase and compare its performance with bleach and other common oxidants and to determine the composition of the optimal formulation of the multioxidant solution.

Practical goals of the project:

On-site production of hydrogen peroxide and the possibility of contamination and unwanted substances

- Reduce the use of chemicals
- Reduce the risk of transportation and maintenance and work with hazardous materials
- Economic efficiency and cost reduction
- Facilitate the work of the operator and no need to pass safety courses
- Safe disinfection and reducing the need for safety equipment
- Stable performance
- Help maintain plant equipment and the environment

Abstract:

In this project, in order to achieve the predetermined goals, planning was done, which finally resulted in the following outputs:

Determining the optimal amount of glucose oxidase enzyme

2. Compare it with other common oxidants in terms of efficiency, price and environmental effects

3. Formulation of multioxidant solution

Steps and Methodologies:

First, the effluent composition was identified and then the effluent volume was estimated. The optimal amount of anrium was estimated according to the volume and composition of the effluent. The feasibility of using bleach and glucose oxidase was investigated in terms of performance, costs, maintenance and environmental effects, and the removal of odors, bacteria, algae, biofilms, etc. was on the agenda.

This project was carried out in three main stages as follows:

1. Gathering information
2. Performing tests - technical and economic evaluation
3. Preparation of formulation and summary

Main Results (technical outputs, patents, papers, books, reports, etc.):

The cooling tower, which is a general unit in the power plant industry, is a suitable environment for the growth of microorganisms in terms of temperature and humidity conditions. Hydrogen peroxide is one of the most effective oxidants used as a disinfectant. The enzyme glucose oxidase ensures the production of hydrogen peroxide under normal conditions and at low cost. In addition, it avoids the potential dangers of storing, transporting, and working with this powerful oxidizer (H_2O_2). It is sulfuric acid and RO unit. The next step includes knowing the values of water flow, bleach, sulfuric acid, temperature, hardness and pH conditions in the unit and then analyzing the operating conditions and checking compatibility with glucose enzyme. Also on the agenda were issues such as sampling and prioritizing areas that are most prone to contamination, and identifying microbes in the water of the cooling tower unit.

Due to the fact that in the report of the first stage, it was found that the running water leaving the cooling tower has a higher microbial load than the static water inside the pond, so the experiments were performed on the running water leaving the cooling tower. In the test design, each test was performed for 2 hours by adding a certain amount of formulation components listed in the relevant table. The unit of measurement of microbial load is CFU / ml, to determine which we inoculate a certain volume of water sample into solid culture media.

According to standard 4207, we first give one milliliter of the sample to a petri dish containing nutrient agar medium for surface culture. The incubation is then performed at 35 to 37 ° C for 24 hours in an incubator, and finally the microbial load is counted with the Kant colony apparatus. It is assumed that after incubation, each microorganism multiplies and creates a visible colony on the solid culture medium or changes in the appearance of the liquid culture medium.

Physicochemical characteristics of cooling tower water: The temperature in the cooling tower reaches 40 degrees Celsius and at the outlet the water temperature is 30 degrees Celsius and the pH is 8-9. The water upstream of the cooling tower is actually the output of the RO part, which has a water hardness of 600 ppm.

The number of bacteria from the effluent of the cooling tower is 2600 cfu / ml and the microbial load of the water inside the pond is 220 cfu / ml.

In this report, experiments related to the optimal dose of glucose oxidase enzyme and its comparison with several oxidizers were evaluated. Equipment required for the use of enzymes including agitators, UV lamps, etc. were evaluated. Also, due to the fact that the outlet water of the cooling towers contains bleach water, at the request of Tarasht power plant, we first checked the microbial load for a week and then two disinfectant formulations for the outlet water of the cooling towers in some cases. With and without bleach was determined by experimental design software. Interaction between variables, validation and model optimization were other measures performed. Finally, the technical and economic aspects of the use of glucose oxidase enzyme in disinfection of the outlet water of the cooling tower of Tarasht power plant were evaluated.