ASSESSMENT OF POLLUTION CONTROL TREATMENT WITH OZONE USING A FUZZY INFERENCE SYSTEM

K.Padmanabhan, Emeritus Professor (Presenting Author) and R.Muthukumar, Professor @ Anna University and S.Ananthi, Professor, Madras University, Chennai

Abstract

Ozone is used for primary and tertiary treatment methods in wastewater from industries and tanneries. The method of application of ozone into the pollutant stream varies from bubble injection to venturi based injection. Among the novel methods, the *in situ* ozonation method is the most effective and economical.

In this method, the ozone generator discharge tube is immersed into the stream or the pipe line itself and the insulation is provided for the high voltage in the glass discharge tube with the outer tube made of a porous ceramic. The discharge generates ozone in the gap between the inner glass tube having a coated electrode and the outer porous ceramic tube, which is at ground potential. Gas emanates through the porous tube.

The control of power in the high voltage is to adjust the ozonation levels, depending upon the requirement from time to time. Where the quantity of the pollutant stream is large, several ozonator units in several parallel pipe lines need to be installed.

For any type of pollutant, the quantity of ozone cannot be estimated easily. The ozone output will depend on the high voltage applied and the temperature of the reactor tube. The former is the control variable. The pollutant stream can be classified into several levels of pollution, from small, medium to high and very high. At times, in tanneries, the levels reach to the very high values. The information of this level is a fuzzy variable actually, since there is no demarcation from small to medium or medium to high in a crisp way. The other variable that needs to be assessed is the flow in the pipe line. At times, the flow is small, but at times when the wastewater throughput is high, the same has to be considered for application of the correct amount of ozone. These and some other variables are formed by fuzzy inferences. The quantity of ozone to be output is related to the apparatus for ozone discharge and its high tension voltage is also a fuzzy variable, from 4KV to 10 KV.

Fuzzy variables are first formed by creating membership functions for the linguistic variables. The inference system (FIS) is generated after creating membership functions for flow and pollution levels. Pollution levels are assessed at the pipe entry

point by an electrolytic sensor and its rough estimate is used for determining the level. Flow is measured by a Coriolis mass flow meter. The fuzzy inference system (FIS) needs a rule data base, which is primarily the task of the pollution control engineer's expertise. Once the rules are fixed, such as : *If flow is high and Pollution level medium, apply medium high voltage.* The output variable is also fuzzified as low, medium and high categories. The FIS system is based on the well known *Mamdani* model. The variables are digitised and used by a microcontroller which is programmed to work with the FIS and generate a de-fuzzified output*, viz*., the control power to the discharge tube for ozone generation.

In this scheme, the entire treatment scheme is controlled automatically by the Fuzzy model based inference system and the same is cost effective in the treatment units. The power requirement of generation of 1 kg of ozone is a few kW, but when large quantities of effluent need treatment, a FIS will save the cost considerably. The paper will discuss the possibilities of improvement in some actual case studies.