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Pollution Control of HCl Synthesis Unit in Chloro-Alkali Industry

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Abstract

Control of chlorine gas release is a major concern for most chlor-alkali industries. Normally manual and proportional-derivative-integral control strategies are provided for control. In HCl synthesis plant there are chances of chlorine leakage to atmosphere under certain fault conditions. The limit of chlorine release at stack is 6ppm and its exposure limit at ground is 2ppm. If the chlorine release exceeds the limits it may cause pollution problems and in turn will affect human life and environment. This project defines a control strategy to limit the chlorine gas release from the stack by a control mechanism that measures the chlorine concentration at the stack and control the inlet flow rate of chlorine gas to the oven. For this control mechanism PID, Fuzzy logic and Fuzzy-PID strategies are used and of the three, Fuzzy-PID is the best controller which would efficiently limit the release of chlorine gas to atmosphere

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Keywords: HCl synthesis; chlorine release; pollution; PID; Fuzzy logic; Fuzzy-PID.

1. Introduction

Air pollution is defined as the addition of various hazardous chemicals, particulate matter, toxic substances and biological organisms into the Earth's atmosphere. In case of chlor-alkali industries the main reason of air pollution is the leakage of chlorine gas to Earth's atmosphere. When chlorine enters the body as a result of breathing, swallowing, or skin contact, it reacts with water to produce acids. The acids are corrosive and damage cells in the body on contact Chlorine exhaust and leakage can be minimized by providing necessary control strategies and mechanisms that would control the chlorine release to atmosphere. This paper proposes such a control strategy that would minimize the release of chlorine from chlor-alkali plants. The control strategy uses Fuzzy logic control and

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PID control mechanisms using Matlab which would provide accurate control to limit the chlorine release from the stack.

2. Problem Definition

The exhaust rate of chlorine is checked by supplying excess hydrogen through a ratio control mechanism that senses the flow rates of both hydrogen and chlorine. This control is enough when the plant is operating at normal conditions. During some fault conditions i.e. condensate collection in hydrogen line, blower loading, line choking, line control valve failure, oven burner tip failure, excess flow rate of purge chlorine etc. will lead to release of un-reacted Cl_2 gas to atmosphere. The limit of Cl_2 release at stack as prescribed by Kerala State Pollution Control Board is 6ppm. If the Cl_2 release exceeds the limits it may cause pollution problems and which in turn will affect human life and environment.

3. Objective

The objective is to limit the chlorine gas release from the stack of oven so as to reduce the effect of pollution. The gas release is limited or controlled by a control mechanism that measures the chlorine concentration at the stack and control the inlet flow rate of chlorine gas to the oven. A chlorine gas analyzer is to be installed at stack that gives signals to the controller about chlorine concentration. The controller controls the inlet chlorine flow rate hence controlling the exhaust chlorine concentration.

4. System Architecture

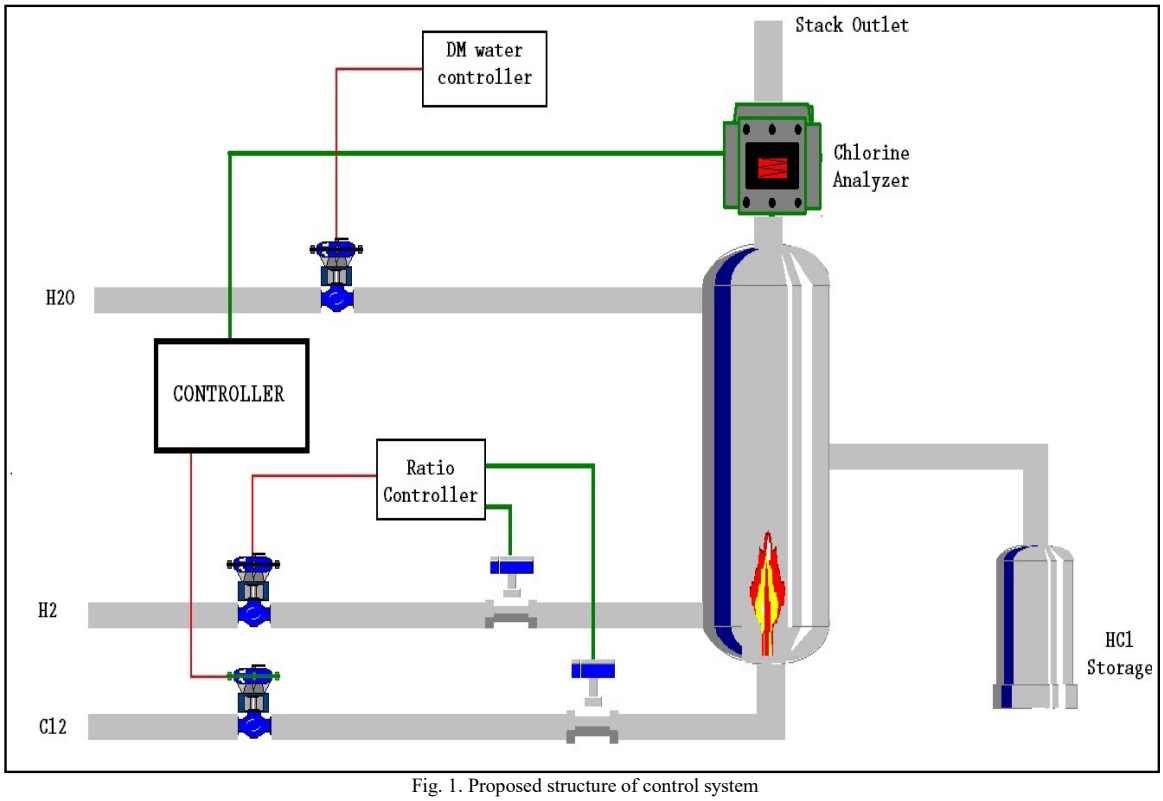

Fig. 1. Proposed structure of control system