IGCC GREY WATER TREATMENT SYSTEM FOR DUKE ENERGY INDIANA'S EDWARDSPORT FACILITY IWC 10-48

Andrew Broerman
Process Engineer
Duke Energy
Edwardsport, IN

M. Adam Edwards
Process Designer
HPD, LLC
Plainfield, IL

ABSTRACT

Duke Energy Indiana is constructing the first commercial-scale coal gasification plant built in the United States in the last 13 years in Edwardsport, Indiana. The plant will use advanced integrated gasification combined cycle (IGCC) technology to convert Indiana coal to a synthetic gas that is used to produce power. The process wastewater from gasification operations (grey water) must be treated to remove contaminants before it can be recycled to the plant or discharged to the environment. Environmental discharge requires exceptionally clean condensate and management of the various feed contaminants. This paper describes the development and design challenges of the Grey Water Treatment System.

INTRODUCTION

Duke Energy is constructing the first large, commercial-scale coal gasification power plant built in the United States in Edwardsport, Indiana. The approximately 618-megawatt plant will use advanced integrated gasification combined cycle (IGCC) technology to convert Indiana coal to a synthetic gas (syngas) that is used to produce power. The syngas is cleaned to remove sulfur compounds, mercury, and particulate matter before being sent to a traditional combined cycle power plant, using two combustion turbines and a steam turbine to efficiently produce electricity. By-products of the gasification process include steam, vitrified slag and elemental sulfur.

Water is used in the cleanup of both the syngas and slag, most of which is recycled to the gasification process. This process wastewater from gasification operations is called grey water after the solids have been removed. The grey water is recycled back into the plant for re-use. However, a purge stream must be removed from the process to control the concentration of chloride, which is present in the coal feedstock. This purge stream is the feed stream to the Grey Water Treatment System

Based on permitting restrictions, the Edwardsport facility required that the treated water recovered from the Grey Water Treatment System be suitable for discharge. However, the discharge may be recycled to the cooling tower to reduce make up water rates. The processed water must meet stringent effluent quality specifications governed by the plant's NPDES permit. The suspended and dissolved solids separated by the Grey Water Treatment System are sent off-site for disposal.

FEED CHEMISTRY AND DESIGN CHALLENGES

The grey water from the gasification process is to be treated to a degree that it may be discharged to the nearby river. This grey water contains ammonium, chloride, and formate ions as the primary contaminants. Other contaminants include mercury, selenium, boron, and arsenic, which are present in very low levels and require careful consideration given the final destination of the treated water.

Duke Energy required a system that would meet the following main objectives:

- Remove dissolved solids from the grey water
- Provide reliable and stable operation.
- Minimize operations and maintenance requirements
- Minimize overall CAPEX and OPEX requirements

Referenced Figures

Figure 1: Grey Water Treatment System Block Diagram

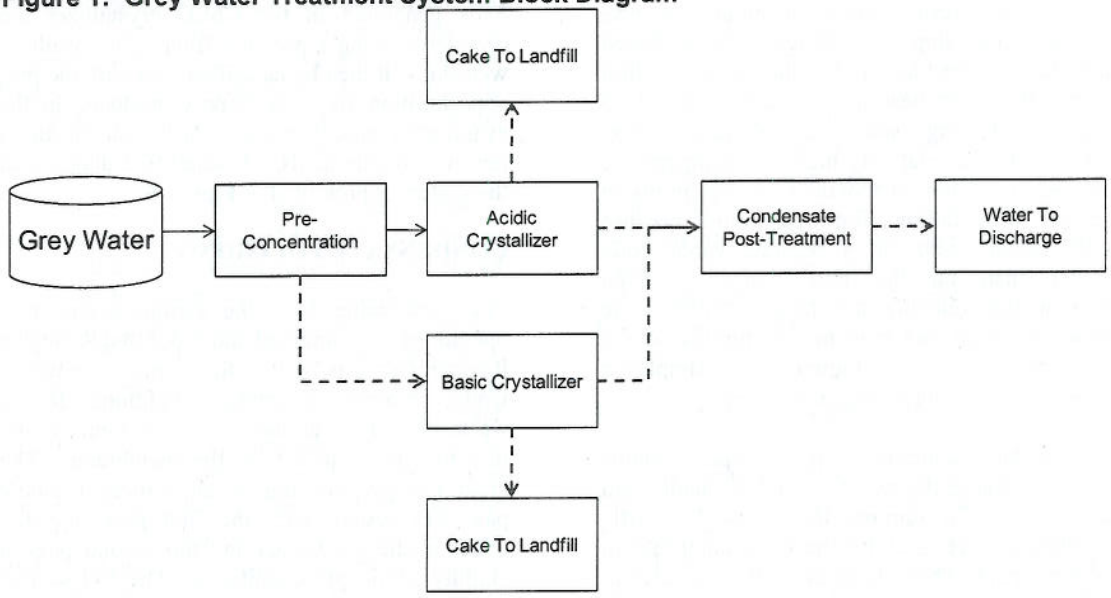

Figure 2: Forced Circulation Pre-Concentration Stage With Integral Vapor Scrubbing

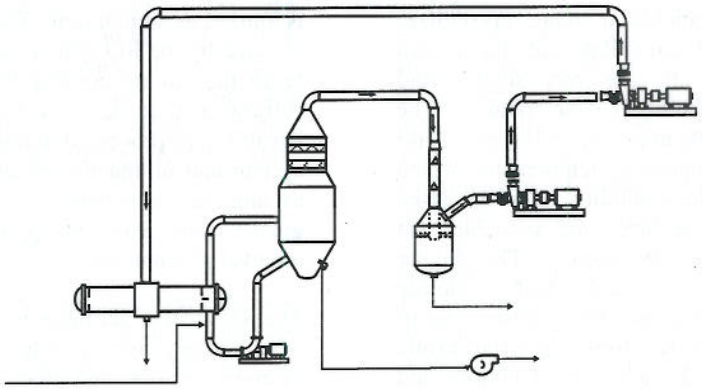

Figure 3: Ammonium Chloride - Solubility and BP At Atmospheric Conditions

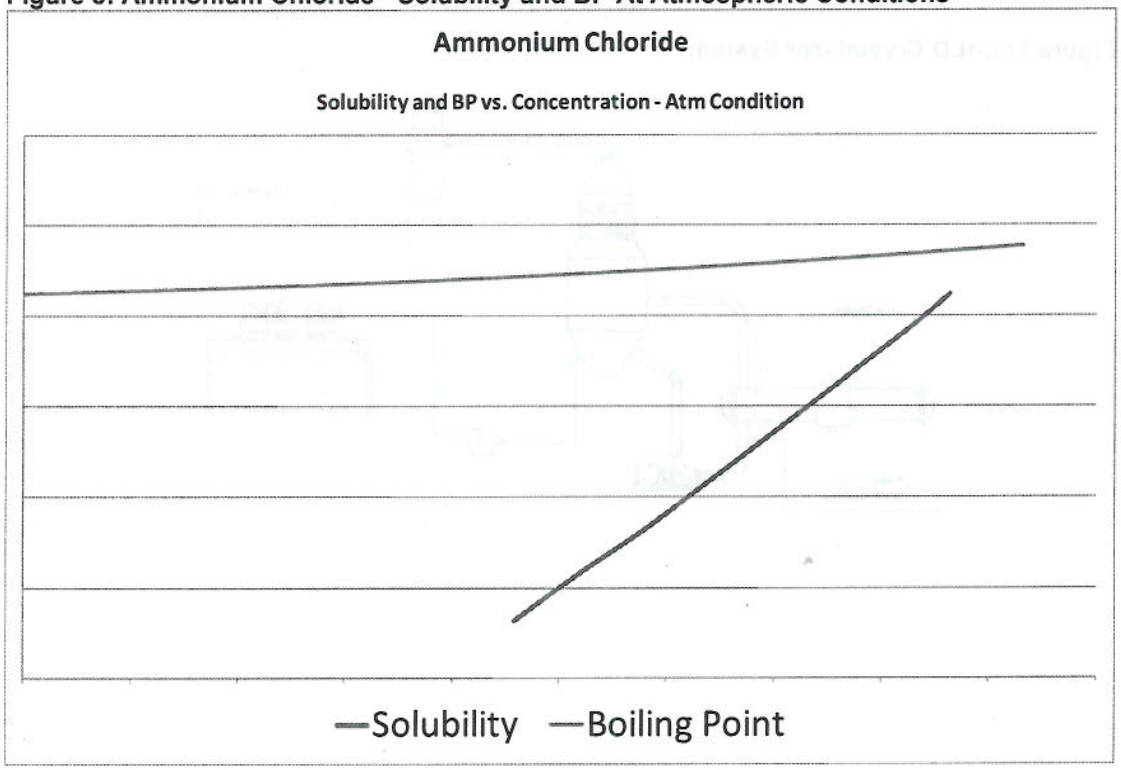

Figure 4: Ammonium Chloride - Solubility and BP At Vacuum Conditions

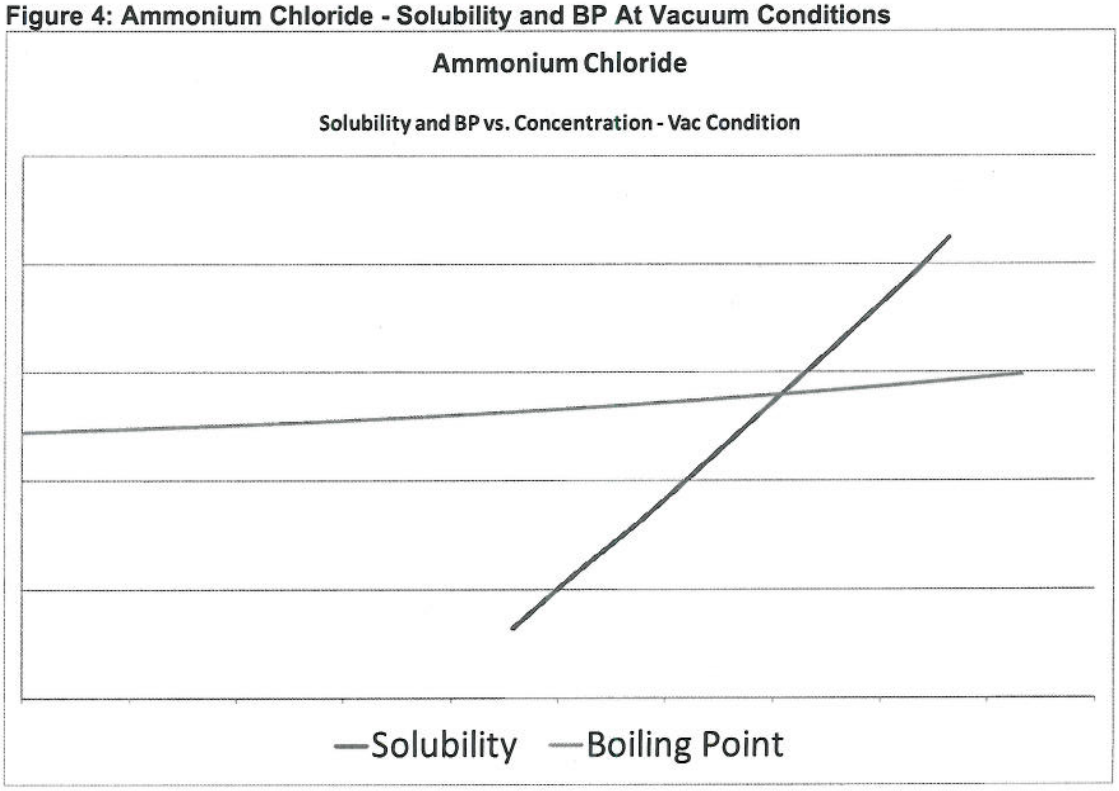

Figure 5: CoLD Crystallizer System