15. Pretreatment of bio-methanated distillery waste by catalytic wet air oxidation (CWAO) to enhance further biomethanation

Preamble:

Indian distillers face the daunting task of effectively treating high volume of concentrated spent wash. This liquid effluent has many unwanted features, viz. high acidity, dark brown color and high chemical oxygen demand (COD). The recovery of precious biogas via biomethanation of the spent wash is most prevalent; besides, a final polishing step by aerobic oxidation is often employed. The biomethanated spent wash however resists aerobic treatment, due to its low biodegradability index (BI < 0.2) and high COD (30000-40000 mg/L). Thus, it is crucial to develop methods for efficiently treating biomethanated wash water. The controlled wet air oxidation (WAO) of biomethanated spent wash at mild conditions is a useful option. In this process, COD is not entirely destroyed whereas biodegradability is much improved. As a result, additional biogas can be recovered before aerobic oxidation. In this work, we applied this WAO technique to the wash water collected from a sugar factory in Maharashtra state.

Objectives of the Project:

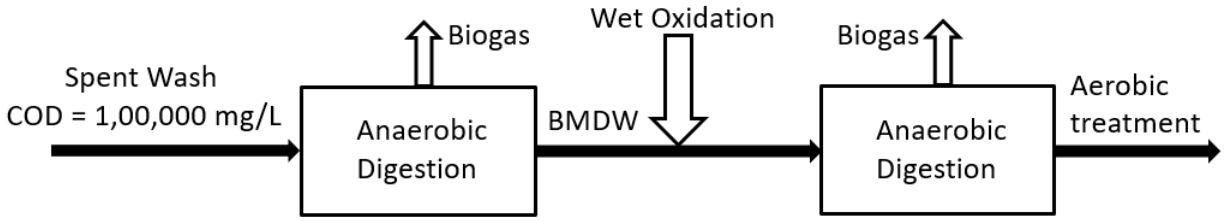
- Wet oxidation based pre-treatment of biomethanated spent wash to enhance biodegradability and biogas generation.
- Demonstration of the proof-of-concept using a laboratory-scale reactor.
- Trials with homogeneous and heterogeneous catalysts.
- Investigation of the effects of process variables and optimization of oxidation process.
- Investigation of kinetics of COD destruction and biodegradability index (BI) enhancement.

Salient Features of the Technology:

In this work, the biodegradability of biomethanated distillery spent wash (biochemical oxygen demand (BOD_5) = 8100 and chemical oxygen demand (COD) = 40 000 mg/L) was improved by oxidation over a ferrous sulfate catalyst. The homogeneous CWAO process was

optimized by investigating the effects of reaction variables, such as temperature (150–225 °C), oxygen partial pressure (0.69–2.07 MPa), and catalyst loading (16–48 mg/L). After oxidation at T = 175 °C for 1 h, adsorption over activated carbon (loading 5%) was performed at ambient temperature. As a result, a 73% reduction in COD and a substantial increase in the BOD_5/COD ratio (from 0.2 to 0.45) was observed. This ratio increased further to 0.52 when anaerobic digestion was performed, using 1% acclimatized biomass. For every cubic meter of wastewater, 1.1 N m^3 of biogas was formed (69% methane). After a final polishing step by aerobic treatment, BOD_5/COD = 0.58 and 91% COD was destroyed. Clearly, this work has provided a useful solution to the effective pretreatment and valorization of biomethanated distillery wastewaters. Lastly, we employed a two-step power-law model to describe the kinetics of COD conversion.

Configuration of the Processing Plant (Section Details):



Proposed Scheme

Technology Transfer:

We showed proof-of-concept with wash waters from two different sugar industries. Currently, we are reaching out to prospective industrial partners for pilot trials.

FOR DETAILS, CONTACT:

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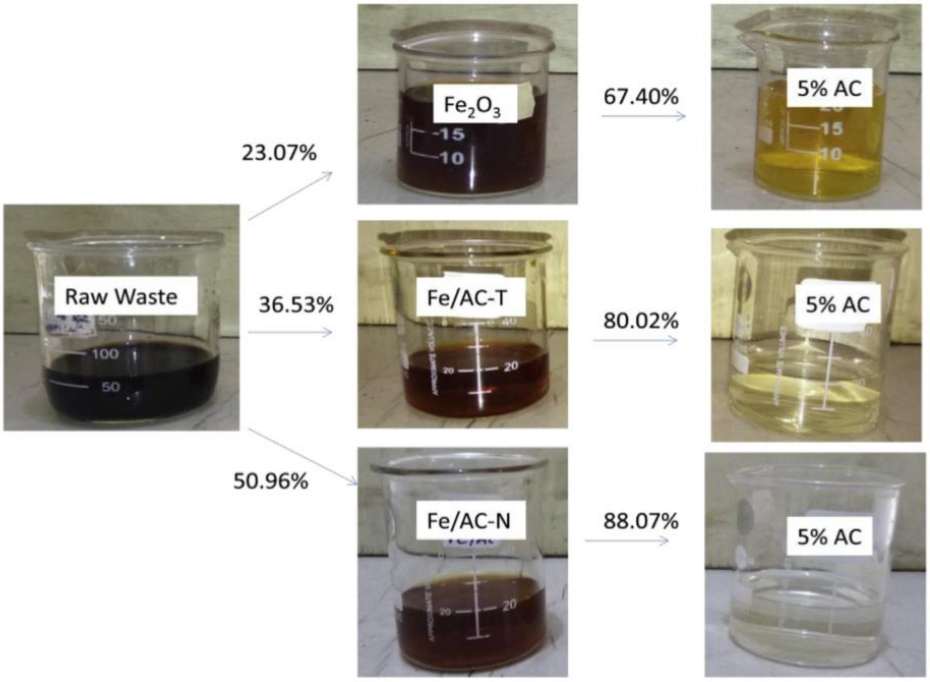
Sample Products Developed under the Project:



Color reduction of waste water after proposed wet oxidative pre-treatment over heterogeneous iron catalyst and adsorption on activated carbon

Photographs related to Project:

WAO REACTOR

TOC ANALYSIS

HPLC

BOD ANALYSIS

COD ANALYSIS