TREATMENT OF SULFIDIC SPENT CAUSTIC USING CATALYTIC WET AIR OXIDATION WITH PURE GRANULAR ACTIVATED CARBON

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Product Background

Wastewater sludge from refinery operations of petrochemical industry has become a problem for most companies due to its diverse range of contaminants such as sulfides, mercaptans, nitrogen dioxide etc. Essentially, sulfidic spent caustic is a very toxic waste that can be classified as reactive and highly corrosive because it contains sulfide, high chemical oxygen demand (COD), highly odorous caustic spent and respectively has a high pH value. Treatment of sulfidic spent caustic was proposed and investigated to be under catalytic wet air oxidation (CWAO) method with pure granular activated carbon which is more environmental-friendly and low cost treatment system.

Novelty

The novelty of this research is the application of sulfidic spent caustic treatment using catalytic wet air oxidation with pure granular activated carbon.

Marketability & Commercialisation

For 500 mL of Sulfidic Spent Caustic:

Table 1: Comparison CWAO treatment with Cu/Al_2O_3 and GAC

CWAO with Cu/Al_2O_3	CWAO with pure GAC
Requires chemical with high toxicity	Not require chemical with high toxicity
Total cat cost = $9.20	Total cat cost = $0.02
***GAC is 90% cheaper than modified catalyst Cu/Al2O3 in treatment of sulfidic spent caustic under catalytic wet air oxidation	

Benefits

- Lower catalyst costs than other alternatives.
- Efficient degradation removal of COD and sulfide.
- 100% natural and safe (No chemical pollution)

Application of CWAO with GAC

Preparation of synthetic sulfidic spent caustic by adding sodium sulfide (3000mg/L).

Temperature were fixed at 110 ℃, air flowrate is 0.15 L/min, GAC is 3g and rate of stirring is 1200 rpm in semi-batch wise mode.

Preparation of sulfide vial while COD vial in COD reactor (HACH).

Check sulfide and COD concentration using HACH UV-Visible Spectrophotometer.

Results

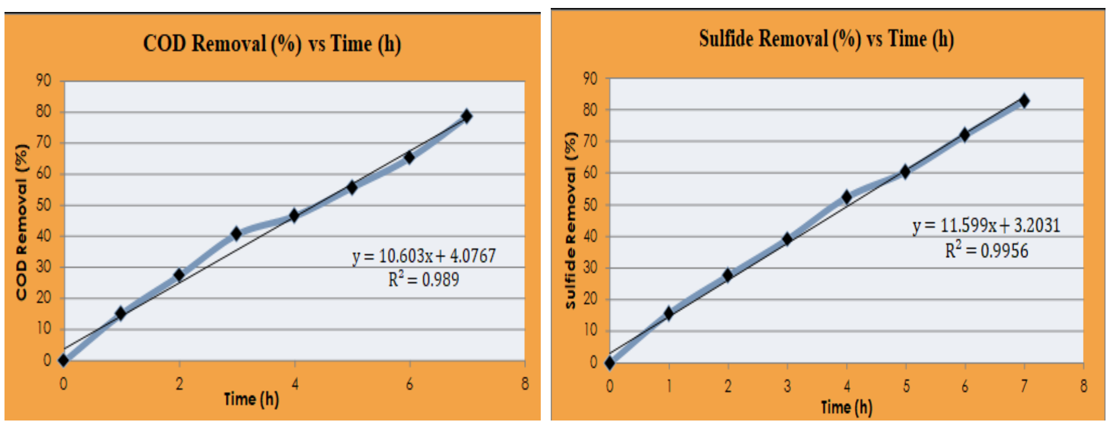
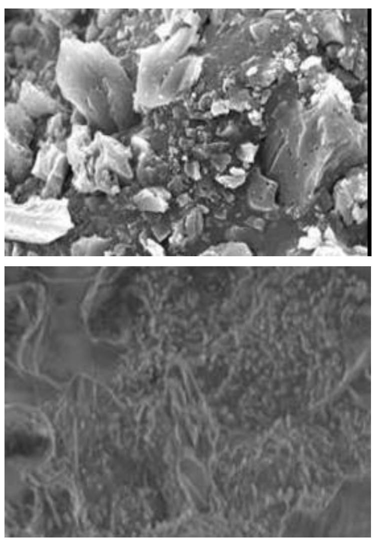


Fig 1: Graph of COD and Sulfide Removal (%) vs Time (h)



(a) (b)

SEM images of activated carbon before (a) and after (b) adsorption process.

The proposed pathway mechanism of sulfide adsorption/oxidation is written as below where X represents an active site in GAC:

1) Adsorption:
   $O_2 + 2X \leftrightarrow O\text{-}X + O\text{-}X$
   $H_2S + X \leftrightarrow H_2S\text{-}X$
2) Surface Reaction:
   $H_2S\text{-}X + O \leftrightarrow H_2O\text{-}X + S\text{-}X$
3) Desorption:
   $H_2O\text{-}X \leftrightarrow H_2O + X$
   $S\text{-}X \leftrightarrow S + X$
   $S\text{-}X + 2(O\text{-}X) \leftrightarrow SO_2\text{-}X + 2X$
   $SO_2\text{-}X + 2X \leftrightarrow SO_2 + X$