



Chemical Leaching of Indian Coal by Using Acids

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Abstract: India is the world's third largest coal producer (after China and United States). Indian coal is characterized by high ash content and low calorific value. Coal minerals are objectionable due to process as well as environmental problems. Demineralisation prior to utilization is an effective way to ensure environmentally friendly combustion of coal and to make the user to use coal for domestic as well as commercial power generation. In the present paper demineralisation of coal is done by using different acid. It was found that mixture of leachant has major effect as compared to using single leachant.

INTRODUCTION:

Indian coal is characterized by high ash content. This high ash limits its use in metallurgy and thermal power plant. The removal of mineral matters from coal has been practiced since its extraction from the earth and studies in to chemical demineralization have been conducted for several decades. Various methods have been practised for demineralisation which include physical method, chemical treatment.

The main disadvantage of physical method is it does not remove the inherent minerals from the coal which necessitates the use of chemical methods. In the way of chemical treatment several chemicals were used which sometimes affects texture, morphology and the calorific value of the coal.

In the present paper some solvents were used for the removal of mineral matter of the coal.

Material and Methods:

Coal Sample: An Indian low grade coal was used in this study. The coal was crushed to the size of 1-3mm and air dried. The proximate analysis is presented in Table.

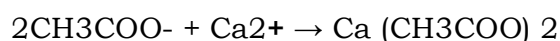
Demineralization: For each sampling 10 gm of the coal was taken and is demineralised by using different Solvent like (50% acetic acid), (50% Citric acid), (50% HCl), (50% H₂SO₄) and mixture of (HCl and H₂SO₄) in a 500 ml Teflon beaker for 24 hours at room temperature (25°C). The leached coal sample was separated from the respective Solution by filtration and naturally dried at room temperature. The resulting samples were washed repeatedly with double distilled water and finally dried in an oven at 100°C. Ash content in the virgin coal and its demineralized coals were analyzed by proximate analysis.

Results and Discussion:

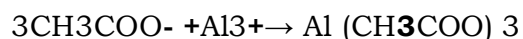
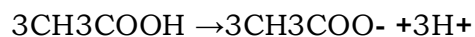
Effect of acetic acid: When the bituminous coal was treated with acetic acid for 24 hrs at 27°C, the ash content

Decreased from 27.3 to 23.4 wt%.



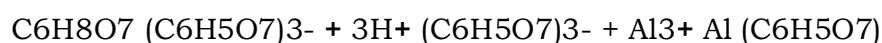


(Calcium acetate)



(Aluminum acetate)

Effect of citric acid: Citric acid contains three carboxylic groups and one hydroxyl group as possible donor of protons (H^+) at 25°C. When alumina cation (Al^{3+}) are present in the coal and citric acid is fully dissociated in aqueous solution, a complexation reaction may take place.



(Aluminium citrate)

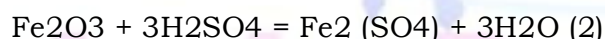
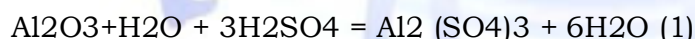


(Calcium citrate)

Effect of HCl on demineralization: the coal mineral get dissolved by reaction with a strong acid (HCl) In solution the ions become completely ionized and are free to react with the silica and alumina layers of the minerals a greater amount of alumina is removed than silica

Effect of H_2SO_4 on demineralization

The aluminium oxide (alumina) and iron associated with the alumina react with sulphuric acid forming aluminium sulphate and ferric sulphate according to (1) and (2)



Characterization of the virgin and demineralized coal

Proximate analysis of virgin coal

Virgin coal	
Moisture	11.2%
Ash content	28.2%
Volatile matter	7.8
Carbon	52.80

Ash content of demineralised coal by using different solvent:

Solvent	Ash content





CH ₃ COOH	23.4%
C ₆ H ₈ O ₇	30.2 %
HCl	29.8%
H ₂ SO ₄	25.4%
Mixture HCl+H ₂ SO ₄	24.0%

Conclusion:

The effect of demineralization on an Indian low grade coal has been studied using chemical leaching method by acetic acid, citric acid, HCl, H₂SO₄ and mixture of HCl+H₂SO₄. The Citric acid leaching removes the Ca and Al containing minerals. The HCl dissolves the salts of weaker acids such as carbonates, borates however Al, Be, Si, Sb are insoluble in HCl. Formation of carbonates increase the ash value of coal. H₂SO₄ alone dissolve most of oxide however it does not have any effect on Pb, Ba, Sr. Mixture of HCl and H₂SO₄ have remarkable effect on ash removal.

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