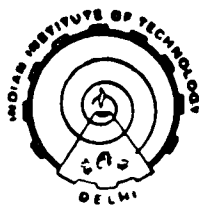


**EXTRACTION ENHANCEMENT OF COAL THROUGH ALKALI
TREATMENT AND PYROLYSIS AND GASIFICATION OF
RESIDUAL COALS OBTAINED AFTER
SOLVENT EXTRACTION**

By
SURENDRA KUMAR SINGH

*Thesis submitted to the
Indian Institute of Technology, Delhi
for the award of the degree of
DOCTOR OF PHILOSOPHY*



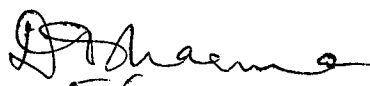
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CERTIFICATE

This is to certify that the thesis entitled "EXTRACTION ENHANCEMENT OF COAL THROUGH ALKALI TREATMENT AND PYROLYSIS AND GASIFICATION OF RESIDUAL COALS OBTAINED AFTER SOLVENT EXTRACTION" by SURENDRA KUMAR SINGH being submitted for the award of degree of DOCTOR OF PHILOSOPHY is a record of original bonafide research work carried out under my supervision for the submission of this thesis which to my knowledge has reached the requisite standard.

The thesis or any part thereof has not been submitted to any other University or Institution for the award of any degree or diploma.



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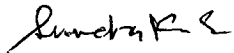
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SURENDRA KUMAR SINGH

ABSTRACT

The object of the present work was to develop some convenient chemical techniques for rendering 50% of the coal extractable in common organic solvents under relatively milder conditions at atmospheric pressure, without resorting to high pressure hydrogenation of coal using inorganic catalysts. It was aimed to use coal derived chemicals as far as possible for the pretreatment (chemical reaction) of coals.

Assam coal was subjected to mild alkali treatments using solid NaOH and aqueous NaOH respectively in different solvents. Pretreatment of Assam coal with solid NaOH in ethanol, butanol, pyridine, phenol, tetralin and benzene/methanol solvents, showed an increase in the extractability of coal in the respective solvent as well as in quinoline. The use of dilute aqueous NaOH (1.5%) for the pretreatment of coal resulted in an increase in the extraction of coal in ethylenediamine (EDA), phenol and tetralin only. Aqueous NaOH pretreatment was found to enhance the extractability of coal in almost all the solvents but it showed the maximum extraction (37%) in EDA. The effect of different reaction conditions was studied on the extraction enhancement of coal in EDA through aqueous alkali pretreatment. Two step aqueous (1.5%) NaOH pretreatment followed at each step by EDA extraction, resulted in 50% extraction of coal. Stepwise treatment of Assam coal with

NaOH in phenol where each treatment step was followed by quinoline extraction, resulted in the extraction of 69% of the coal after three alkali treatment steps in phenol. Alkali treatment of Assam coal at its plastic stage using liquid paraffin also resulted in the extraction of more than 50% of the coals. The degree of demineralization of coal by dilute aqueous alkali treatment followed by acid treatment was found to be 75%. A comparative study of the solvent extraction of Neyveli lignite through dilute aqueous alkali treatment in phenol and through the acidic depolymerization of lignite by phenolation showed that the former reaction results in rendering more lignite extractable than (that) through the latter.

More than 50% of the Assam coal was rendered extractable through successive extractions using AO-EDA-LP solvent sequence. Extraction of coal in AO and LP proceeded through extractive disintegration of coal. Cetene was found to render more than 50% of the coal extractable (in the solvent and in quinoline and anthracene oil respectively). Biodegradation studies of Assam coal and Neyveli lignite were carried out using soil microorganisms, Pseudomonas and Coryne bacteria. Some of the microorganisms showed encouraging results.

Pyrolysis studies were performed on Assam coal in steam atmosphere to study the effect of heating rate, final

temperature and time of pyrolysis on the devolatilization of coal. The studies on the steam pyrolysis of Talcher coal at 650°C, AO, AO-LP and AO-EDA-LP extracted Talcher coal residues were performed and these were found to give appreciable yields of tar through the pyrolysis at 650°C. The residual coals obtained after solvent extraction, chars obtained from the steam pyrolysis of the (solvent extracted) residual coals and from the original coal were subjected to steam gasification and these were found to show good reactivity for the gasification in steam.

Above mentioned studies would help in studies of the organic chemical structure of coal. These may also ultimately help in developing the relatively cost effective and convenient technology for getting the solvent refined coal (for liquefaction) at atmospheric pressure and under relatively milder conditions, employing coal derived chemicals and solvents.

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