RHEOLOGICAL PROPERTIES ESSENTIAL FOR THE ATOMIZATION OF COAL WATER SLURRIES (CWS).

Quarterly Progress Report
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OVERALL OBJECTIVE:

The overall objective of this project is to perform experiments to understand the effect of high shear and extensional properties on the atomization of coal-water slurries (CWS). In the atomization studies, the mean drop size of the CWS sprays will be determined at various air-to CWS. A correlation between the extensional and high shear properties, particle size distributions and the atomization will be made in order to determine the influence of these parameters on the atomization of CWS.

PROJECT STATUS:

The Chemistry Department has just purchased a Fourier Transform Infrared Spectrophometer. Plans are currently underway to purchase a Diffuse Reflectance Cell accessory. This accessory will be used to study kinetics of oxidation of the coal samples currently under study. Three coal samples: PSOC 1339, 1475 and 1527 have been received, ground and sieved, and separated into different particle size fractions.

FTIR Studies

Coal particle surfaces are heterogeneous in nature. They consist of an organic part, i.e., of hydrocarbon portions with associated functional groups (mainly phenolic, carbonyl, and carboxyl groups), and an inorganic part (pyrite, clay minerals, which constitute the ash content. The oxygen content of the coal

however decreases with the rank of the coal. The higher the rank, the higher the carbon/oxygen ratio. A high carbon/oxygen ratio has been found to be neccessary for stability and handling of CWS.

The C/O ratio of the coal surface is decreased by the process of aging or oxidation during which polar functional groups such as COOH, CO, and phenolic OH, are formed. Diffuse Reflectance Infrared Spectroscopy is one technique in which changes in the coal surface due to oxidation can be studied.

During the past quarter, a technique has been developed in order to study the rate of oxidation of the coal surface using FTIR. The extent of the oxidation of the coal sample can be monitored by observing the ratio of the intensity of the C=O stretching band at 1690 cm^{-1}. The intensity of the carbon-hydrogen aliphatic stretching mode near 2900cm-1 decreases with increasing oxidation. A band attributable to a carbonyl moiety grows in near 1690cm-1, and there are differences in the C-O (ether) bands centered near 1200cm-1. By studying the evolution of these changes with increasing oxidation of the coal. The Kinetics of the oxidation process and the extent to which the oxidation influences the quality of the slurry designed to be used in this study.

Figures 1-3 show the FTIR spectrum of the coal samples as recieved. The kinetics of coal oxidation study will allow a relation to be established between the rate of oxidation of the coal samples and changes in the rheological properties of the CWS with time.

PLANS FOR NEXT QUARTER

The variation of the intensity of the C-H aliphatic stretching band near 2920cm-1 will be measured after the diffuse reflectance accessory has been purchased. There are several reason for studying this band. Fredricks and Moxon have shown that the C-H aliphatic mode stretching region is the spectral region most sensitive to oxidation [1]. Also, that spectral region is well isolated from other bands in the coal spectrum. The absorptivity of the aliphatic C-H stretching mode bands is intermediate in strength, so that those bands are not the strongest in the spectrum. This is advantageous because very strong bands tend to be overly sensitive to slight sample preparation and very weak bands are heavily influenced by noise in the spectrum. For this reason, the region between 3100 and 2800cm-1 will be ideal for the study of coal oxidation. Also, coal slurry preparation and characterization will begin. The rheological properties will be related to changes in the absorption band of the C-H band at 2900 cm^{-1}.

REFERENCE

1. Fredricks, P.M. and Moxon, N.T., Fuel, 1986, 65, 1531

Figure 2. FTIR Spectra of PSOC-1475
(Elkhorn #3)

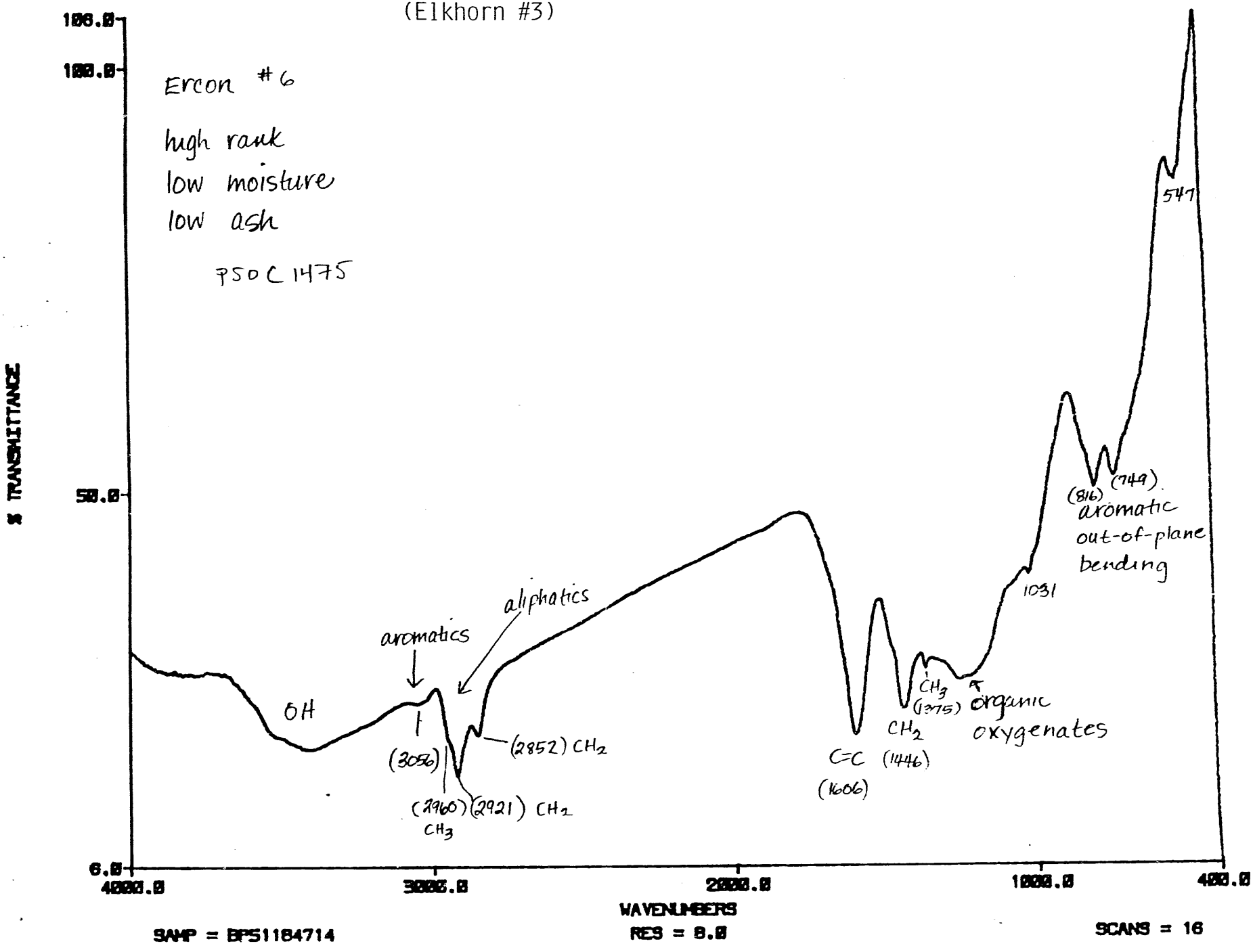


Figure 1. FTIR Spectra of PSOC-1339
(Middle Kittaning)

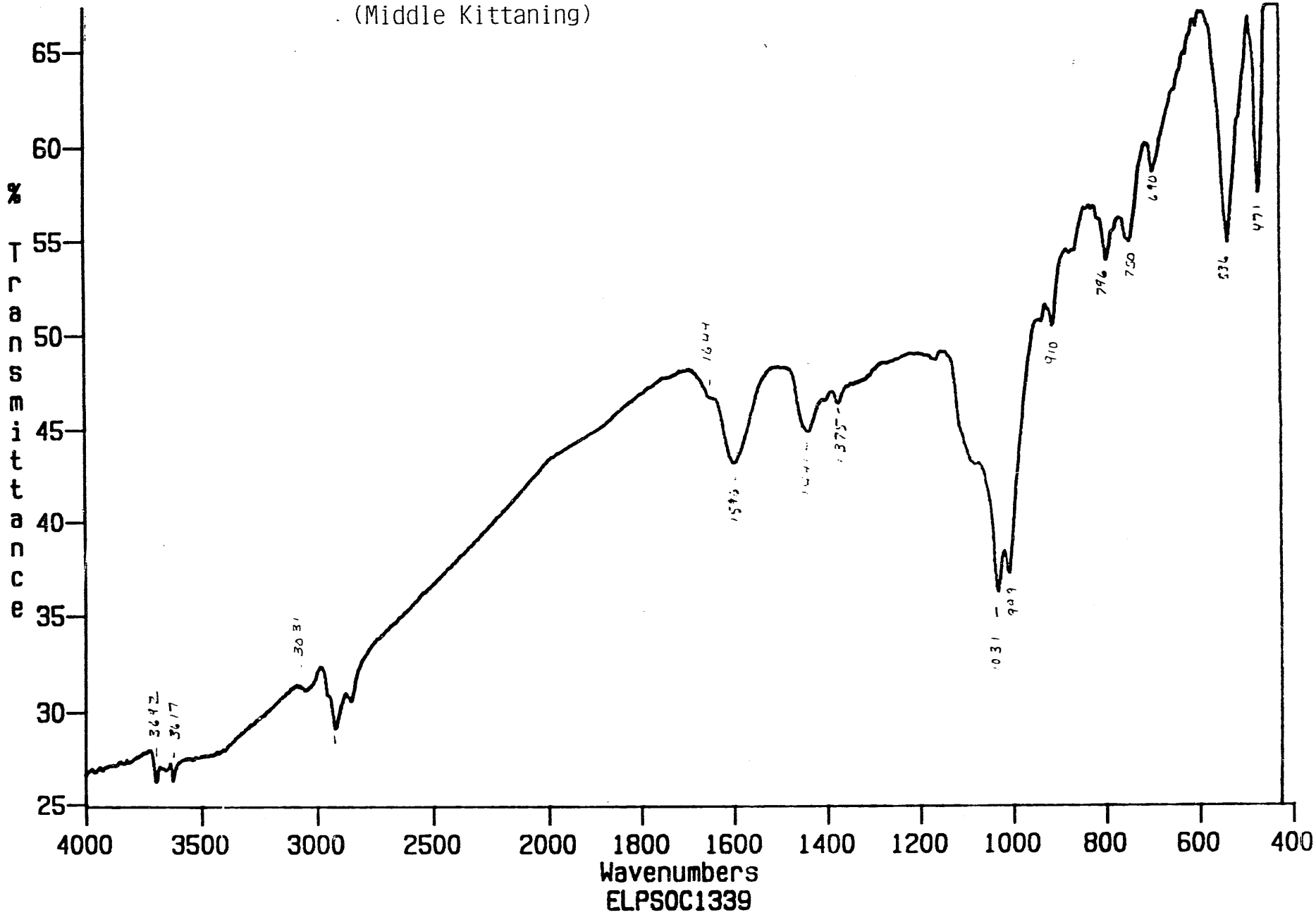
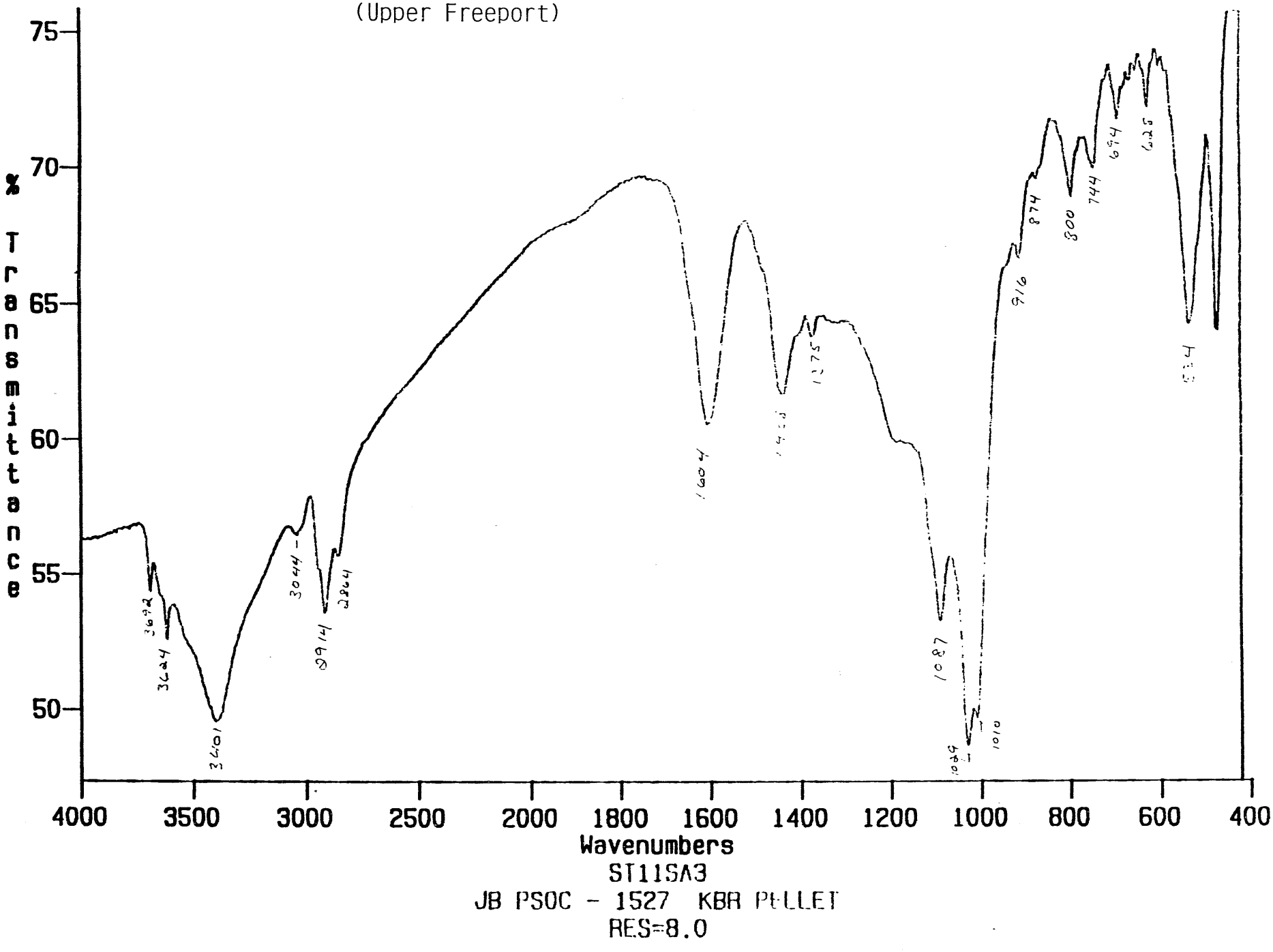


Figure 3. FTIR Spectra of PSOC-1527
(Upper Freeport)



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