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Technical Progress Report

to

Department of Energy
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PELLETIZATION OF FINE COALS

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1. Project Overview

Pelletization is the unit operation of producing larger bodies from fine powders so as to alleviate many of the problems associated with fine particulates. For example, some of the benefits provided by pelletizing coal fines include improved fugitive dust control, decreased transportation losses, reduced risk of coal freezing, and lowered risk of spontaneous combustion. Only a partial understanding of the fundamentals of coal pelletization and the role of binders exists today.

The present research project attempts to provide a simpler basis for determining the pelletizability of fine coals, to ascertain the role of binders and to establish a basis for binder selection. Currently, there are no generally accepted techniques for determining the quality of coal pellets. Our research is intended to develop a series of tests on coal pellets to measure their storage characteristics, transportability, ease of gasification and rate of combustion. Information developed from this research should be valuable for making knowledgeable decisions for on-time plant design, occasional binder selection and frequent process control during the pelletization of coal fines.

2. Progress During Last Quarter

During this quarter, we have been concentrating on the development of suitable techniques for the production of coal pellets and the evaluation of their characteristics. Our past research involved the usage of the batch pelletization procedure for understanding the pelletizing behavior of coal fines and ascertaining the influence of coal characteristics and operating variables on pelletization kinetics. During batch pelletization, pellets tend to grow by the mechanisms of nucleation and coalescence and occasionally tend to form raspberry type agglomerates. Also, the batch technique produces pellets with a wide size distribution, we have developed a new two-step procedure to obtain coal pellets within a narrow size range (say $9 \text{ mm} \pm 2 \text{ mm}$).

The first step consisted of producing a batch of seed pellets (in the size range $-4.75 + 4.00$ mm) by pelletizing of 200 g of ground coal with desired additives (surface active agents and binders) and moisture content for 800 revolutions. The seed pellets are obtained by sieving the output from the batch drum. The second step involved the production of finished size pellets by layering the seed pellets with stepwise addition of moist feed which is again produced with desired additives and moisture content. Specifically, 25 g of the $-4.75 + 4.00$ mm seed pellets are placed in the drum and 20 g of moist fluffy feed is added every 80 revolutions for five times. After 400 revolutions the pellets are sieved on the 4.75 mm screen and the screen undersize which corresponds to new seeds generated during the layering cycles is discarded. Now, 30 g of moist fluffy feed is added every 50 revolutions for five more cycles. These layered pellets are sieved again and the $-9.5 + 8.00$ mm pellets.

Coal agglomerates produced by the above described technique are nice and spherical. With our past experience with iron ore pelletization we learnt that as long as sufficient fluffy feed is available for the consumption by the seed pellets, they generally grow by forming layers consuming the feed rather than grow by coalescence. This is found to be true in the case of coal also. Growth by coalescence of coal pellets is found to yield raspberry type uneven agglomerates. After ascertaining the possibility of producing nice spherical pellets, several experiments have been conducted to develop the above standard procedure for making pellets in a reproducible way and testing them for their quality.

Agglomerates produced by this standard technique are subsequently tested for determining the following properties:

1. compressive strength of wet pellets,
2. drop strength of wet pellets,
3. compressive strength of dry pellets,

4. abrasion resistance of dry pellets, and
5. resistance to water penetration of dry pellets.

We have conducted several preliminary experiments during the last quarter. We are planning to continue these studies with various additives and binders including dodecane, dextrin, different kinds of starch and lignin derived and humic acid derived binders and asphalt emulsions. The purpose of these studies is primarily to understand the role of additives during coal pelletization.

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