BRIQUETTING ANTHRACITE FINES FOR RECYCLE

Salustio Guzman
Research and Development Laboratories
QIT-Fer et Titane Inc., P.O. Box 560, Sorel
Quebec, Canada, J3P 5P6

John T. Price
Energy Mines and Resources Canada
Energy Research Laboratories, CANMET
555 Booth Street, Ottawa, K1A 0G1

Keywords: Anthracite fines, Briquetting, Recycle

ABSTRACT

Pennsyvania anthracite is employed at QIT as reductant in electric arc furnaces, for the production of metal iron and Titanium dioxide rich slag from ilmenite. Fines are generated at the drying stage of anthracite, prior feeding to the electric arc furnaces, and represent approximately 3.4 % of the annual amount of anthracite used at QIT.

The size of these anthracite fines make them unsuitable for their direct use at the electric arc furnaces, because during feeding, they would be lost to the wet gas scrubbers. Briquetting of anthracite fines allows recycle of these materials for smelting ilmenite at QIT.

The paper presents results of a laboratory study for briquetting anthracite fines with a pitch binder, on the physical properties and chemical composition of the briquettes and, also discusses the proposed plant flowsheet for briquetting.

QIT's metallurgical operations in Quebec consist of an open pit mine located in the Allard Lake region, 500 miles north of Montreal, where an ilmenite ore is extracted and, the operations in Sorel where, the ore is beneficiated before smelting in electric arc furnaces. Smelting produces a titanium dioxide rich slag which is used as feed stock by pigment producing companies, and liquid iron metal which is processed further for production of different grades of pig iron, production of steel billets at QIT's steel plant and, production of iron and steel powder products at QIT's metal powders plant QMP.

Smelting at QIT in electric arc furnaces, consists of a carbothermic reduction of iron oxides present in the ilmenite in a molten bath. The reducing agent employed for smelting is Pennsylvania anthracite which is delivered to Sorel by boat.

The anthracite reductant prior to feeding to the electric arc furnaces is dried in three rotary louvre type driers, which use the arc furnace fuel gas (85 % CO and 15 % H2) produced from the iron oxide reduction. The drying operation removes 8 to 8.5 % moisture from anthracite as received at Sorel.

Fines are generated in the drying stage and are entrained in the gas exiting the driers. Fines represent approximately 3.4 % weight of the total annual amount of anthracite used at QIT, which is separated from the gas by cyclones and wet gas scrubbers.

Typically anthracite fines contain 75.38 % fixed carbon, 5.7 % volatile matter, 0.68 % sulfur 18.92 % ash, and 79 % of the particles are bigger than 38 microns. The relative high ash content in the fines relative to the 9.6 - 10 % ash content in dry anthracite, is consistent with the fact that, coal fines in general are associated with higher ash content.

The laboratory experimental work was carried out at the Energy Research Laboratories of CANMET in Ottawa. A batch laboratory size twin roll briquetting machine manufactured by K. R. Komarek, model B-100 was employed for the tests, this machine is equipped with, 130 mm diameter and 50 mm width rolls, and produces pillow shape briquettes with 12 x 12 x 40 mm dimensions.

The only binder tested was type II roofing asphalt, because this carbonaceous binder is compatible with the nature of anthracite reductant.

The experimental range of conditions for briquetting were: 5 - 14 % wt binder, and 6880 - 13760 pounds briquetting pressure, as summarized in Table 1.

Good quality green briquettes were produced for 10 and 12 % binder additions at 6800, 10320 and 13760 pounds of pressure, with more than 90 % of the initial mixture weight briquetted with the 12 x 12 x 40 mm target size.

Green briquettes with the best drop and abrasion resistance properties, were produced for 12 % binder addition and 10320 pounds pressure, these briquettes, withstood 9 ft drop tests without breakage while, the rest of the briquettes withstood only 6 ft or less high drop test.

The green briquettes containing 10, 12 and 14 % binder additions were crushed, for producing briquetted anthracite material smaller than the original 12 x 12 x 40 mm briquette size produced. A roll crusher was employed for crushing the briquettes, and the particle size distribution ranges from 1.13 cm (3/8") to 130 microns (100 mesh), as shown in Figure 1.

The + 10 mesh fraction of crushed green briquettes were subject to abrasion tests, employing an ASTM tumbler for coal, which procedure was modified to accommodate to the coarse granulometry and smaller weight of the crushed samples. Once again, the crushed green briquettes containing 12 % binder addition and briquetted with 10320 pounds of pressure, exhibited the highest abrasion resistance, with only 16.6 % decrease in the average particle size from 6420 microns before to 5355 microns after tumbling while, larger average particle size reductions ranging from 29.4 to 37.2 % are experienced after tumbling the + 10 mesh fraction of crushed briquettes containing 10 % binder additions.

In summary, use of 12 % type II asphalt roof binder and 10320 pounds briquetting pressure constitute, the optimum experimental conditions for producing briquettes with desirable drop and abrasion resistances, necessary to withstand handling and transport within the feeding system for recycle at QIT, for crushed or non crushed briquettes produced from anthracite fines.

The successful completion of the laboratory testing has led to the proposal of a flowsheet for briquetting anthracite fines, as illustrated by the schematic flowsheet shown in Figure 2. It is estimated that, a 5 metric tonnes per hour briquetting plant would be more than sufficient for processing the anthracite fines generated at QIT.

TABLE 1

EXPERIMENTAL CONDITIONS FOR BRIQUETTING ANTHRACITE FINES

ROLLS SPEED (RPM)	AUGER RATE (RPM)	BRIQUET. FORCE (LBS)	MOISTURE CONTENT (% WT)	BINDER CONTENT (% WT)	FINES WEIGHT (g)
1.818	32.25	10320	3	5	7077
1.818	32.25	10320	3	7	7077
1.818	32.25	10320	3	9	7077
1.818	32.25	10320	7	5	7000
1.818	32.25	10320	7	7	7000
1.818	32.25	10320	7	9	7000
1.818	32.25				
1.818	32.25	6880	3	12	7077
1.818	32.25	10320	3	12	7077
1.818	32.25	13760	3	12	7077
1.818	32.25	6880	3	10	7077
1.818	32.25	10320	3	10	7077
1.818	32.25	13760	3	10	7077
1.818	32.25	6880	3	12	7077
1.818	32.25	10320	3	12	7077
1.818	32.25	13760	3	12	7077
1.818	32.25	6880	3	14	7077
1.818	32.25	10320	3	14	7077
1.818	32.25	13760	3	14	7077

FIGURE 1

PARTICLE SIZE DISTRIBUTION OF CRUSHED BRIQUETS

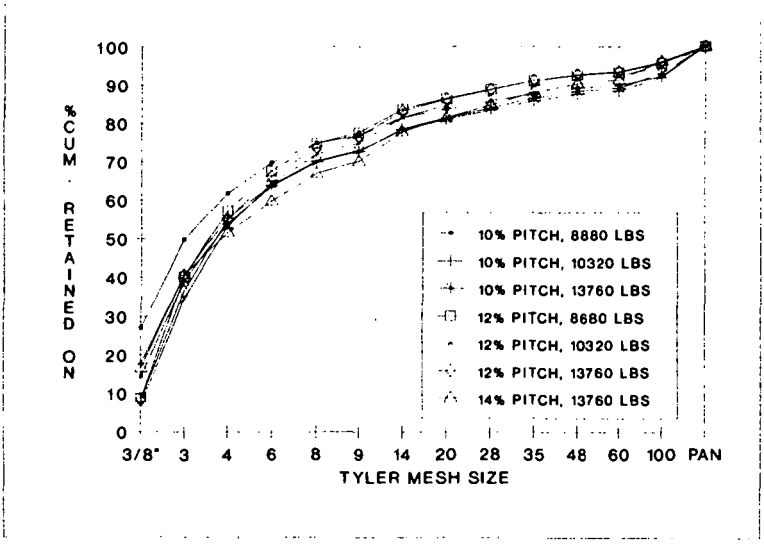

FIGURE 2

ANTHRACITE FINES BRIQUETTING

SCHEMATIC OF PROPOSED FLOWSHEET