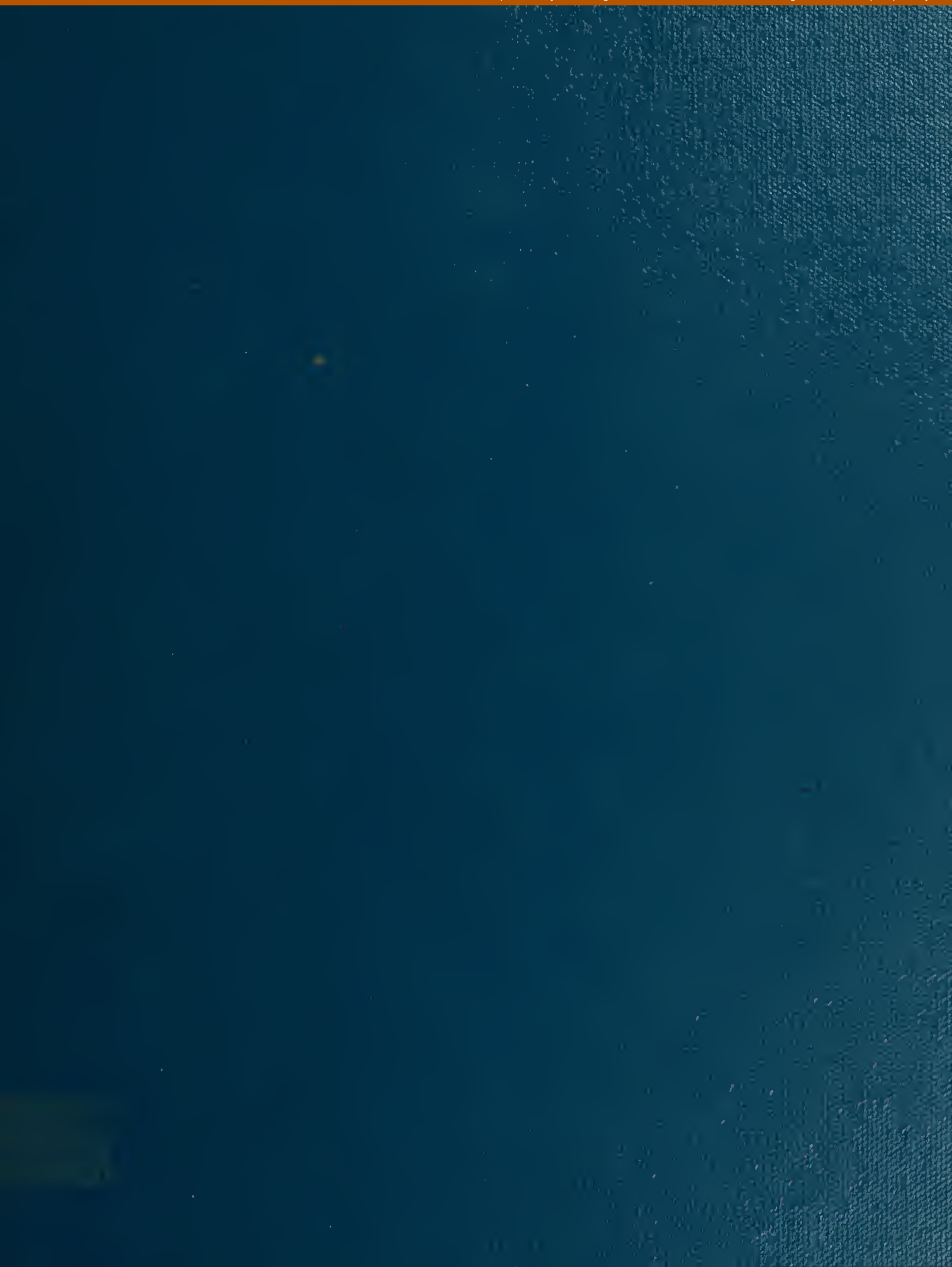

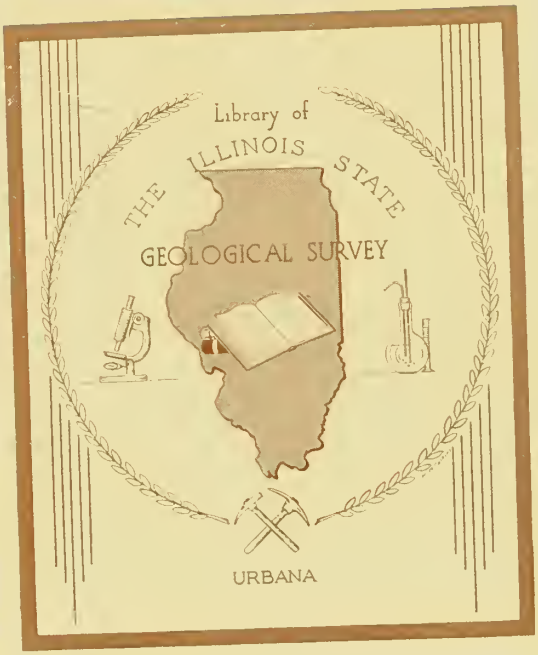

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PELLETIZING ILLINOIS FLUORSPAR

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ABSTRACT

Fluorspar mined in southern Illinois faces stiff competition from imported spar. Illinois producers are attempting to regain lost markets by greater beneficiation of their products. Flotation spar, high in CaF_2, is now briquetted to form a product uniform in composition and size. Pellets also are being produced in pilot-plant quantities, and a commercial fluorspar pelletizing plant is under construction.

Tests on pilot-plant pellets indicate that they have sufficient strength and resistance to weathering to withstand transportation and plant storage. Advantages over imported gravel spar include their high percentage of CaF_2, low content of zinc and sulfur, uniform composition and size, and a domestic source of supply.

ILLINOIS FLUORSPAR PRODUCTION

Fluorspar, CaF_2, has been mined in southern Illinois since 1842 and to date has provided more than half the total fluorspar produced within the United States. The eminent position of Illinois as a fluorspar producer stems primarily from the location of its deposits, which lie at relatively shallow depths in an area accessible by railway, highway, and waterway to major centers of industrial, chemical, and steel production.

Initially fluorspar was used primarily in production of glass, enamel, hydrofluoric acid, and, to a minor extent, in foundry and smelting operations. When open-hearth steel production was begun in the United States, fluorspar consumption increased rapidly, reaching a maximum of 645,000 tons in 1953. For more than 60 years the steel industry accounted for 75 to 80 percent of the total tonnage consumed. However, for the past 9 years, the chemical industry has used more fluorspar than the steel industry because of great increase in hydrofluoric acid production.

Fluorspar as mined in Illinois is concentrated by heavy-media separation and by flotation. It is marketed in three general grades - metallurgical, ceramic, and acid. Metallurgical spar normally contains from 60 to 72.5 percent effective CaF_2 (the CaF_2 available after reaction with the silica present in the spar). Ceramic grades range from 85 to 96 percent CaF_2, and acid grade spar contains 97 percent or more.

MEETING FOREIGN COMPETITION

Prior to World War II, most fluorspar used in the United States was mined domestically. Since that time imports of fluorspar, primarily from Mexico, have increased greatly, and in 1962 slightly less than one-third of the spar used in the United States was produced in this country.

In an effort to recapture a portion of this market, Illinois producers have begun to process their product into pellets or briquettes which they believe will have certain advantages over the gravel spar imports, and, for certain uses, over the unagglomerated flotation spar normally produced and sold domestically.

The gravel spar from Mexico that is normally sold to the steel industry contains not over 72.5 percent effective CaF_2. The pieces range in size from about 2 inches to dust, with an allowable 10 to 15 percent under one-sixteenth of an inch. Pellets or briquettes can be produced from flotation spar of any grade. Their effective CaF_2 content may range up to 94 percent and can be controlled both by the grade of spar and by the nature and quantity of the binder used in processing. Pellet size can be kept uniform at any desired level from about 1 inch down to one-eighth of an inch or smaller. Undersize is reduced to a minimum.

FLUORSPAR BRIQUETTES

The first flotation spar in Illinois to be beneficiated in size was briquetted into almond-shape pellets approximately an inch long. Similar briquettes of a slightly different shape are still produced. An organic binder is used in their preparation. After they have been formed, they are heated to 550°F to give them a hard, dense structure. The finished briquettes are frequently called "peach seeds" because of their original size and shape. They may be packaged in 10-pound cellophane bags for easy handling. Their uniform size and composition favor their use in processes requiring precise control of fluorspar additions. However, their use by the metallurgical industry has been limited.

FLUORSPAR PELLETS

Pilot Plant

Fluorspar producers in southern Illinois have recently been experimenting with pilot-plant production of pellets from flotation spar. The pellets are formed on a rotating "pelletizing disc" mounted at about 60 degrees from the horizontal. Dry spar, water, and binder are fed into the disc continuously. As the disc rotates, balls of spar roll up like snow balls and overflow when they reach a desired size. Size can be controlled by the angle at which the disc is mounted and by the speed of rotation. A liquid sodium silicate (water glass) has been found to give satisfactory results as a binder, although other binders might be used. The fluorspar pellets contain 10 to 15 percent water when they roll out of the disc, but they are sufficiently firm to maintain their shape until they are dried and hardened in an oven.

Physical Tests

Pellets made in this pilot plant have been tested at the Illinois State Geological Survey laboratories for resistance to breakage and abrasion by tumbler and shatter tests. Results of these tests were found to depend on the amount of binder used and the temperature to which the pellets were heated, but both laboratory and plant tests have shown that pellets made by regular pilot-plant procedure have sufficient strength to withstand handling during transportation and plant use.

Porosity of the pilot-plant pellets is about 15 to 20 percent. They absorb water readily when immersed, but after removal from the water they dry quickly at room temperature. Pellets heated to 500°F are hard but when immersed in water for 60 hours and subsequently dried they lose weight. This is due, for the most part, to solution and loss of a portion of the water-glass binder. When dropped 6 feet onto concrete, a majority of these partially leached pellets break. Similar pellets heated to 700° or 750°F show almost no loss in weight after 60 hours of water immersion, indicating that the binder has been made less soluble by the higher temperature These pellets can be bounced on concrete without breaking.

Commercial Production

A commercial pelletizing plant with a capacity of 5 tons per hour is under construction at a spar mine in southern Illinois. Operation will be patterned after that of the pilot plant just described. When the plant is completed, sufficient pellets will be available for extended tests in metallurgical and other plants.

The commercial fluorspar pellets, as well as the briquettes now available, will have certain advantages over imported gravel spar because they have a larger percentage of effective CaF_2, their composition is uniform, they handle easily, they are low in fines and impurities such as zinc and sulfur, and the mines and processing plant are close to industrial users throughout the Midwest.