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WHITEHEAD BROTHERS FOUNDRY SAND OPERATION LUGOFF, SOUTH CAROLINA

By

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The Whitehead Brothers Company of New York City, long one of the leading producers of foundry and industrial sand, with plants in New Jersey, New York, and New England, recently moved into the Southeast with a modern new operation near Lugoff, South Carolina. This 50-t.p.h. plant is located at a deposit between Lugoff and Blaney, 15 miles northeast of Columbia, South Carolina. This deposit was found after a long search for sand similar to that found in New Jersey from which similar products can be made. Most of the output is foundry sand, and shipments are made throughout the southeastern states, from Virginia to Alabama and Florida.

The plant is of more or less standard design and uses the latest methods and equipment. A washing and classifying department makes five standard sizes and any desired specials. The five standards are stockpiled for feed to the drying department, to which they can be fed in straight sizes or in any desired blends between No. 35 and No. 140 A.F.S. foundry sands. Various specials, including industrial sands, can also be made. This plant was designed by the company's staff.

The deposit on the 1,600-acre property ranges up to 90 feet in depth, with a light clay overburden only in spots; but it has some brush and trees. The sand is fairly white, even before processing. It averages 42 to 50 A.F.S. and 100 percent through 12-mesh and is well graded, with subangular grains. A typical chemical analysis of this sand after treatment follows:

SiO_2	-	99.40 percent
Fe_2O_3	-	0.01 percent
Al_2O_3	-	0.28 percent
TiO_2	-	0.019 percent
Cr_2O_3	-	0 percent
CaO	-	0.01 percent
MgO	-	Trace
Loss on Ign.=	-	0.20 percent

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The 10-ft. average bank is dug by two 2-cu. yd. Michigan front-end loaders which also remove overburden as needed. Three Ford F600 end-dump trucks haul a few hundred feet to the plant. There they dump to a feed hopper or, if this is full, to a stockpile with a capacity for about three days' operation of the plant. Rehandling to and from this pile is done by a Northwest crane with a 3/4-cu. yd. clamshell bucket.

A Syntron vibrating feeder discharges the sand from the hopper to an 18-in. by 116-ft. belt conveyor. The latter discharges to a head box, where water is added to the sand before it flows onto the 4- by 8-ft. Link-Belt CA 248 two-deck screen. Only one deck is being used now, with 8-mesh stainless steel cloth having .041-in. wires. This screen has Link-Belt sprays. The oversize, consisting mainly of roots, is flumed to waste.

The sand passing through the screen is flumed to a 36-in. diameter Link-Belt Shaw classifier used for scalping out coarse. The coarse sand goes to a sump, from which a 4-in. Allen-Sherman-Hoff rubber-lined pump discharges to the feed cone of the 9-ft. diameter by 48-in. Hardinge conical mill. This is loaded with 15 to 20 tons of 1½ in. Grinding Balls, Inc., Ni-Hard steel balls.

The amperage drawn by the mill motor is the guide for adding balls to compensate for grinding loss. This mill is driven at 18 r.p.m. by a 250-hp. Allis-Chalmers induction motor through a Falk reducer. The scouring action of the mill completely cleans the product and removes any surface stain on the grains. The product goes to a sump, from which a 4-in. A.S.H. pump feeds it to a hydroseparator.

The fine-mesh material overflowing the scalping classifier goes via the flume to the hydroseparator.

In this flume there is a 4-in. opening to a pipe with a Flex-Valve rubber clamp valve. Discharge is into a sump from which another 4-in. A.S.H. pump feeds through a 4-in. line to a separate classifying tower. There it discharges to a 20-in. by 14-ft. Link-Belt double-screw washer operating at 30 r.p.m. The dewatered material drops to a pile as A. F.S. No. 35B sand (minus 12-mesh).

Water and fines overflowing the screw washer return through a pipe to the 25-ft. diameter by 8-ft. deep Hardinge hydroseparator, which also receives the fines from the scalping classifier and the mill product. Fines overflowing the hydroseparator are flumed to settling ponds.

The minus 12-mesh product of the hydroseparator goes to another 4-in. A.S.H. pump which feeds it to the main sand classifying flume which is 2 ft. deep, 4 ft. 3 in. wide, and 180 ft. long. Spaced 60 ft. apart on this flume are three 36-in. diameter Link-Belt Shaw classifiers which make, respectively, No. 52, No. 72, and No. 100 A.F.S. sand. These products drop to stockpiles. A dam ahead of each classifier slows the flow.

The flow past these classifiers goes to a 15-ft. Link-Belt Rotoscoop at the end of the flume, which makes A.F.S. No. 140 plus sand that also drops to a stockpile. The overflow from the Rotoscoop also goes to the settling pond.

The sand from the three Shaw classifiers can, if desired, be fed back by gravity to the sump under the scalping classifier and to the mill for finer grinding.

The settling bed mentioned above receives overflow water and fines from the hydroseparator and Rotoscoop. It overflows into a 25-acre pond fed by two small streams. This pond, in turn, overflows back into the streams. (It is the source of water for the plant.) A 2,000-g.p.m. Goulds pump feeds water to a surge tank supplying the wash plant. 1,200-g.p.m. Goulds pumps supply the water used on the screen, the screw washer, and elsewhere.

Stockpiled sand is moved out from the five piles by Michiganfront-end loaders to aerate and drain; it is also loaded by them into trucks for the short haul to the sand drying plant. At this point the five basic sizes can be blended to any desired specification.

The sand is discharged via a hopper and a Syntron electric vibrating feeder to an 18-in. by 56-ft. belt conveyor, which discharges to the 12-in. screw feeder of a 9- by 32-ft. Link-Belt Roto-Louvre drier. The latter has a Hauck gas or oil burner which can be used for either fuel; it is now burning natural pipeline gas. A 42-in. diameter metal duct curving 180 deg. carries heat from the furnace without flame. The furnace and duct are lined, but the drier is not.

A Minneapolis-Honeywell control system is used to hold inlet air temperature to 800-900 deg. F., exhaust air at 350 deg., and static pressure at the discharge end at ½ to 3/4 in. There are separate Brown-Honeywell recorders for the two temperatures and for the pressure.

Hot air from the drier is drawn through a pair of 5½-ft. diameter Link-Belt cyclone collectors by a 15,200 c.f.m. draft fan, which is followed by a steel stack. The collected fines can run in with the drier discharge when fine sands are being processed; when coarse sands are being made, it goes to a pile.

The drier product is discharged to a 3- by 8-ft. Link-Belt UP138 single-deck screen. Wire screen cloth of various mesh sizes is used, depending on the product being made. The screen oversize, mostly foreign matter, is wasted.

The screen throughs are finished products and are discharged by a bucket elevator to a shuttle belt conveyor over a row of four 100-ton Marietta concrete stave silos. This conveyor can discharge the products into the silos, and it can direct them to cars or trucks through telescopic chutes or to a conveyor under the silos. The latter conveyor feeds to another elevator to a hopper; from this hopper trucks or cars can be loaded, or it can feed to the bagging building.

Bagging is done by a Kraft Bag Corp. automatic weighing packer, and the multiwall bags are sewed by a Union Special sewing machine. Most products are sold in 100-lb. bags, but bags of other sizes are used for some specials. There is ample warehouse space for the many products made at this plant. Other company-made materials and products for the foundry trade are also stocked including binders, bentonites, pitches, flours, etc.

Officers of Whitehead Brothers Co. are: James H. Whitehead, chairman, president, and general manager; C. B. Somers, executive vice-president in charge of sales; C. G. Bernstrom, vice-president in charge of production; C. Charles McKay, treasurer; and R. J. Maddison, secretary. L. Tomlin is superintendent of the Lugoff plant.

UNDERGROUND STORAGE OF NATURAL GAS

IN SOUTH CAROLINA

By

H. S. Johnson, Jr.1/

As yet there are no known oil or gas fields in South Carolina. All natural gas used in the state is brought in by pipeline from sources in Louisiana and Texas. Figure 1 shows gas pipeline facilities in South Carolina as of January 1, 1959. Potentially the state may also be supplied to some extent by barge or tanker through the ports of Beaufort, Charleston, and Georgetown. There is also a possibility that the current increased interest in exploration for oil and gas along the Atlantic Coast may lead to discoveries of natural gas in the coastal area of South Carolina or adjacent states.

Underground storage for natural gas has not been developed in South Carolina to date, but considerable thought has been given to the feasibility of it. Geologically, there are three possibilities. These are caverns in granite and gneiss of the Piedmont, caverns in the Cooper marl (Eocene-Oligocene) near Charleston, and watersand storage in the lower Coastal Plain.

Caverns in granite and gneiss

The northwestern half of South Carolina is part of the Piedmont Province and is underlain by a complex terrane of igneous and metamorphic rocks. The metamorphic rocks range from phyllite and fine-grained sericite and mica schist to high rank schists and gneisses containing garnet, staurolite, kyanite, and sillimanite. Large areas of relatively homogeneous granite, granite gneiss, and gabbro are common at many places in the Piedmont. Of particular interest are granite and granite gneiss bodies underlying or immediately adjacent to the Transco gas pipeline near Belton in Anderson County and Fountain Inn in Greenville County. Even though the gneiss has in many places been formed from original sediments, it clearly has been involved in plastic deformation and has undergone partial mobilization in situ so that the rock is now essentially homogeneous in its physical characteristics. Several quarries to depths of 100 feet or so in granite gneiss in the upper Piedmont show the uniformity and general absence

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OF WATER-FILLED FRACTURES IN THIS ROCK. GRANITE, GRANITE GNEISS, AND GABBRO SHOULD ALL BE SUITABLE FOR THE CONSTRUCTION OF STORAGE CAVERNS. AT DEPTHS BELOW 300 FEET, OPEN JOINTS OR FRACTURES ARE RARE IN THESE ROCKS. ANY FRACTURES THAT WERE ENCOUNTERED COULD BE SEALED OFF BY GROUTING. ROCK REMOVED IN EXCAVATING A STORAGE CAVERN WOULD MEET SPECIFICATIONS FOR AGGREGATE FOR A VARIETY OF PURPOSES, INCLUDING DAM AND HIGHWAY CONSTRUCTION.

CAVERNS IN COOPER MARL

OVER AN AREA OF ABOUT 1,000 SQUARE MILES CENTERING ON THE PORT OF CHARLESTON, THE COOPER MARL OF EOCENE AND/OR OLIGOCENE AGE MAY BE WELL SUITED FOR UNDERGROUND STORAGE CAVERNS (FIG. 1). THIS FORMATION IS AN OLIVE GREEN SILTY-FEELING MARL CONSISTING OF 25 TO 75 PERCENT CARBONATES, 10 TO 45 PERCENT SAND, 2 TO 5 PERCENT CLAY, UP TO 20 PERCENT PHOSPHATE, AND ABOUT 15 TO 25 PERCENT WATER (MALDE, 1959, P. 9).

IN APPEARANCE AND PHYSICAL CHARACTERISTICS THE COOPER MARL IS QUITE HOMOGENEOUS. THOUGH VERY POROUS AND SATURATED WITH WATER THE MARL HAS AN EXTREMELY LOW PERMEABILITY. IT CAN BE EXCAVATED RAPIDLY AND AT VERY LOW COST. WATER FOR THE CITY OF CHARLESTON HAS FOR MANY YEARS BEEN OBTAINED FROM THE EDISTO RIVER THROUGH A 23 MILE LONG, 7 FOOT DIAMETER, UNLINED TUNNEL IN COOPER MARL. TUNNEL CONSTRUCTION COSTS WERE A LITTLE LESS THAN $10 PER FOOT FOR 18.61 MILES CONSTRUCTED IN 1936-37 (GIBSON, 1942, P. 121). IN 1959 A SHORT TUNNEL WAS CONSTRUCTED FOR AN OVERALL COST OF ABOUT $13.50 PER FOOT. INSPECTION TRIPS THROUGH THE SEVERAL TUNNELS NOW IN USE HAVE SHOWN THAT SLOUGHING OF ROOF AND WALLS IS PRACTICALLY NON-EXISTANT, THOUGH THE UNSUPPORTED TUNNEL IS AS MUCH AS 70 FEET BELOW THE GROUND SURFACE IN PLACES.

THE COOPER MARL IS ABOUT 150 TO 200 FEET THICK IN THE CHARLESTON AREA AND IS USUALLY OVERLAIN BY LESS THAN 80 FEET OF YOUNGER, UNCONSOLIDATED SEDIMENTS. A POSSIBLE OBJECTION TO STORAGE CAVERNS IN THE MARL IS THE DIFFICULTY OF OBTAINING DEPTHS GREATER THAN 200 TO 250 FEET. THE EXTREMELY LOW PERMEABILITY OF THIS FORMATION SUGGESTS, HOWEVER, THAT SATISFACTORY STORAGE COULD BE OBTAINED AT DEPTHS LESS THAN THOSE NORMALLY REQUIRED. THE POSSIBILITY OF OBTAINING GREATER DEPTH BY TUNNELING OR SINKING SHAFTS IN THE MARL SOUTH AND EAST OF THE CITY OF CHARLESTON SHOULD ALSO BE CONSIDERED. THE COOPER MARL THICKENS AND HAS A GENTLE ORIGINAL DIP IN THIS DIRECTION.

Water-sand storage

In the lower Coastal Plain of South Carolina interbedded sands and clays of the Tuscaloosa and Black Creek formations of Upper Cretaceous age provide an environment potentially suitable for natural gas storage. These units total 500 to 2,000 feet or so in thickness and make up most of the geologic section below depths of about 500 feet. The rocks have been only very gently folded, but closed structures probably exist. Some faulting is known and may have caused traps also. Stratigraphic traps formed by overlap of younger clayey units on older sands may also be expected. Eventually, accumulating geophysical data and subsurface information from drilling will point toward specific areas where water-sand storage of gas may be successful.

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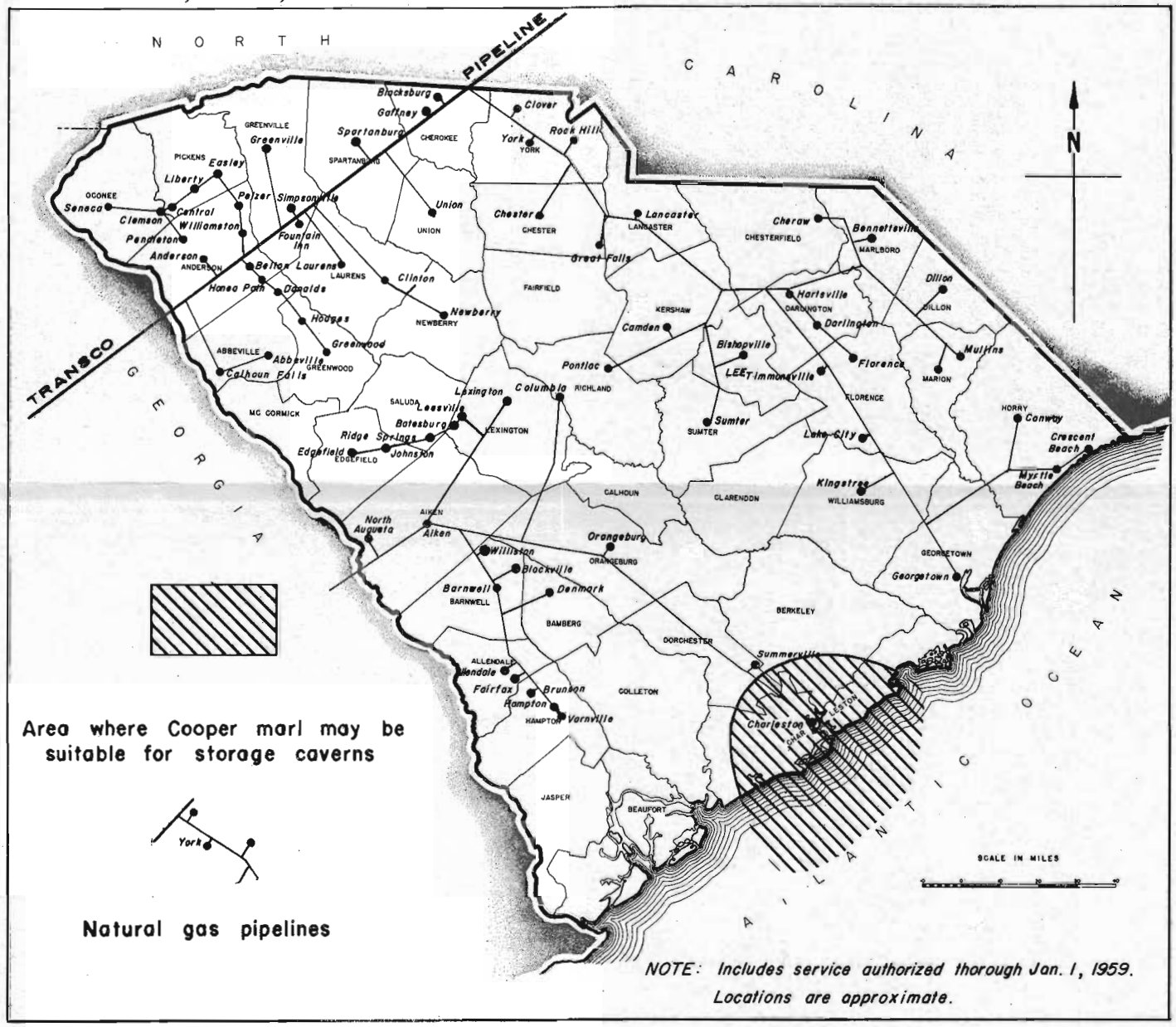

FIG. 1. NATURAL GAS PIPELINE FACILITIES IN SOUTH CAROLINA.