AMERICAN SMELTING AND REFINING COMPANY

ASARCO

CENTRAL RESEARCH LABORATORIES

SOUTH PLAINFIELD, N.J. 07080

January 4, 1966
Re: 669

READ BY ANSD

Memorandum to:
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PLAINTIFF'S EXHIBIT ASA-211

Capco, Ragland, Alabama
Plant Visitation - Process Description

The Cement Asbestos Products Co., Ragland, Alabama, was visited during the period December 7, 8, and 9, 1965 by the writer and by R.G. Crane on December 9. Ragland is located approximately 45 miles northwest of Birmingham, Alabama, with a population of about 1500 people. The Capco Plant is situated immediately adjacent to the National Cement Company, which, like Capco, is a subsidiary of the Woodward Iron Company. Administrative offices of the parent company are located at Woodward, Alabama, approximately 15 miles southwest of Birmingham.

Mr. S.D. Weaver, President and Manager of Capco is assisted by the following men in plant operation:

1) Mr. E.D. Perry, Assistant Manager
2) Mr. L.E. Downing, Superintendent
3) Mr. C.E. Cobb, Laboratory Supervisor

The Capco pipe-making process utilizes the Mazza principle, and at this time is operating with one machine. A used machine, somewhat lighter in construction and older than the present equipment but of the same J.M. Voith Co., Austria, construction will be added to the plant early in 1966.

Plant operation, at this time, is on a 5-day, 3-shift basis averaging 22 hours of pressure pipe production per day. Annual production from one machine is estimated to be 20,000-25,000 tons of finished pipe. With the addition of the second machine, this should increase to 40,000 tons.

Current production is limited to pipes and couplings of 4-, 6- and 8-inch sizes, with an average production rate as follows:

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4-inch, 4 tons per hour

6-inch, 5 tons per hour

8-inch, 5-1/2-6 tons per hour

The proposed increase in equipment will allow for greater flexibility of operation, and pipe of up to 20 inches will be produced.

The present plant labor force consists of 70 men working 3 shifts. Plant maintenance consists of 1 electrician, 2 millwrights and 2 welders on the first shift and 1 electrician and 1 millwright on the second and third shifts.

A schematic flowsheet of the Capco production process is appended to this report and a description of the operation is as follows:

1) <u>Fiber Processing</u>

A batch of 600 pounds of fiber is conveyed from fiber storage to a 1/2-ton capacity kollergang. With the rolls in motion, the fiber charge sequence is chrysotile followed by blue. The fiber charge addition, taking about 1-1/2 minutes, is followed by the addition of 15% water by weight of the fiber. Total kollergang retention time after the addition of water is six minutes. The kollergang discharges to a 15-ton capacity fiber holding bin from which a weighed charge for feed to the turbopulper is drawn. This charge is stored for ultimate feed, with cement and silica, to the turbopulper.

2) <u>Mix Make-up and Slurry Preparation</u>

Cement and silica are drawn from storage silos in predetermined quantities and stored together for feed, with fiber, to the turbopulper. A preweighed fiber charge is fed to the turbopulper with water and fiberized for thirty seconds at a [illegible] solids concentration. The cement plus silica charge is then added to the turbo and the total mix is [illegible] at high speed for an additional two minutes at a [illegible] solids concentration. The slurry treatment time was originally of six minutes duration, but Capco realizing this retention time was overly shortening the fiber length, reduced the treatment to the present two-minute cycle.

This slurry is pumped to a stock chest which acts as a holding tank in which the slurry is agitated by a ribbon mixer rotating at about 20 rpm. The stock chest delivers concentrated slurry to a central feed box which discharges to the cylinder vats of the pipe machine. The slurry is directed to the vats via a trough in which water is added to the 29% solids slurry for dilution to 2% solids. At the base of the trough, and before entering the vats, the slurry is mixed with a dilute (.1 lb. per ton of dry material) solution of Jaguar No. 507 for flocculation purposes.

3) Pipe Formation

The cylinder vats contain paddle agitators mounted in the lower corners to prevent settling of the slurry. The slurry level is maintained at about three inches above the center line of the cylinders. The cylinders are covered with 50-mesh phos-bronze screen and are sealed at the ends. Because of this, liquid is removed from the vat only through the cylinder screen which leaves a thin, even deposit on the surface. Thickness of the film is controlled by the speed of the cylinder, level of slurry in the vat and solids concentration.

Stock is transferred from the surface of the cylinders to a continuous felt at the points of contact as the felt moves over the cylinders. Water is drawn from the stock as the felt moves over several vacuum boxes before reaching the take-up mandrel.

As the felt containing the stock passes under the mandrel, the stock is transferred to the mandrel continuously until the build-up of stock reaches the required thickness. Stock belt speed is approximately 130 feet per minute.

The forming pressure of the stock on the mandrel is controlled by pressure rolls to satisfy the requirements of pipe density and thickness. The pressure rolls, covered by a continuous felt similar to the stock felt, exert pressure to the upper portion of the stock build-up on the mandrel. Maximum forming pressure is exerted on the stock mandrel at the beginning of pipe formation and the pressure decreases continually as the desired pipe thickness is approached. Forming pressures for various pipe sizes are:

4-inch, 120 psi maximum

6-inch, 160 psi maximum

8-inch, 180-200 psi maximum

Following the formation of the pipe the mandrel is transferred automatically to a set of calender rolls where the pipe is loosened from the mandrel. This is done by inserting a jet of high velocity air between the mandrel and pipe while in motion at approximately 100 rpm. The combination of injected air and centrifugal force affects the release of the pipe from the mandrel.

4) Pipe Cure

The mandrel is directed to a pressure oven for the purpose of obtaining sufficient early pipe strength to allow for removal of the mandrel from the pipe. The mandrel is conveyed by rollers through a 100-foot long enclosed oven in a hot, humid atmosphere of 160°F and 90-100% humidity. Retention time is 1-1/2-6 hours.

After discharge from the pre-cure oven the mandrel is extracted from the pipe and the pipe, having sufficient strength to be handled, is loaded in cart racks for further cure.

The racks are conveyed by tow-motor to a 90°F, 100% humidity room where the pipes are further pre-cured for six hours, a change from an original two-hour cure to give greater strength at that stage.

The pipe racks, which are wheel mounted, are then placed on rails in an 8-foot diameter by 145-foot steam autoclave capable of handling ten rack cars at maximum capacity. A full autoclave handles 35 tons of 4-inch pipe, 42 tons of 6-inch pipe and 36 tons of 8-inch pipe. Curing time is approximately 16-18 hours using boiler generated steam at approximately 100 psi and 335°F. After autoclaving the pipes are cooled for several hours in preparation for physical testing.

5) Pipe Testing:

Fully cured pipes are each subjected to machining and testing for band strength and hydrostatic burst test.

Each pipe is externally tapered on each end and then tested according to AWWA (American Water Works Association) and ASTM specifications for asbestos cement water pipe.

The 13-foot, 2-inch standard pipe is tested in flexure over a 12-foot span. The total test load, divided equally, is applied at the middle one-third length of the clear span and is dependent upon pipe diameter and class (maximum working pressure).

The hydrostatic burst test is made on each pipe and coupling which must have sufficient strength to withstand an internal hydrostatic pressure according to specification for the rated working pressure of the pipe class.

Following testing each pipe is fitted with a standard coupling and is stacked for storage.

6) Miscellaneous

a) Typical Fiber Blend and Mix:

Capco bases its fiber requirements for hollanderaging from suggested point values ascribed to asbestos fibers by the J.M. Voith Co. as follows:

Fiber	Weight/ batch (lbs.)	%(1)	J.M.Voith Co. Point Value(2)	Blend Strength Points ((1)x(2))
4K3	200	33.3	85	28.33
4T3	200	33.3	68	22.66
5R3	100	16.67	50	8.34
Blue(Kuruman R3W10)	100	16.67	68	11.34
	600	100.00		70.67

Voith states that 70-74 total blend strength points are required for pressure water pipe and 60-64 points are required for sewer pipe.

Each batch of feed to the turbopulper consists of 500 kg (1100 pounds) of cement + silica. Voith requires that each batch containing cement, silica and fiber has a value of 16.8 points.

Then, $\dfrac{\text{70.67 (blend strength points) x amt. fiber required}}{16.8}$

= 500 kg (cement + silica) per batch

and, amount fiber required = $\dfrac{500 \times 16.8}{70.67}$

= 119 kg blended fiber per batch.

Therefore, total batch feed to turbopulper

= 500 kg cement + silica (60:40)	= 80.78%
+ 119 kg fiber	= 19.22%
619 kg total mix	100.00%

b) Felt Characteristics:

The felt weave is considered to be more important to dewatering than the surface area of the fiber. A loose weave felt is considered best for this purpose and is easier to clean.

Cleanliness, age, and felt condition are critical to the operation. Each endless nylon and wool felt costs approximately $1200, takes about two hours to change and weighs 250 pounds dry. The upper felt (dewatering) has a life expectancy of 200-250 hours equivalent to approximately 700-900 tons of production. The lower felt (stock) has a 150-hour life and 500-ton production expectancy.

c) Couplings:

Standard couplings are made from pipe stock on special mandrels and have a wall thickness somewhat greater than pipe. They are cut to length and internally machined in the pre-cured state. Capco pressure-fit couplings are of a special S.D. Weaver design.

d) Pipe Stock Control:

During pipe formation the edges must be defined and relatively sharp. If the edges taper more than 1-1-1/2 inches it is an indication that the mix at the stock roll is too wet. The required resistance to flow at the edges is helped by the presence of blue fiber in the mix.

To satisfy requirements of the bend test the center one-third of the pipe length is several one-hundredths thicker than the outer portions of the pipe. This is done by directing more slurry flow to the central portion of the vat cylinders.

e) Cement:

The Capco plant uses a modified Type I cement, which is an intermediate between Type I and Type II. It has been found that Type II cement results in relatively poor early strength making handling of the "green" pipe difficult. Cement surface area is approximately 3100-3300 cm^2/gm.

The following analysis is typical of the Type I cement being presently used. Also is shown an analysis of the Type II cement which can result in unsatisfactory green strength. Cements are from the National Cement Co., Ragland, Alabama.

Analysis (%)	Type I	Type II
CaO	63.00	62.80
SiO_2	22.40	24.10
Al_2O_3	5.50	4.06
Fe_2O_3	2.30	3.74
MgO	2.78	2.43
SO_3	2.26	1.57
Ign. Loss	2.10	1.25
Insol.	.28	.19
Alk. (Na_2O equiv.)	.36	.30
Free CaO	1.10	.40

(Cont'd)

Analysis (%), Cont'd	Type I	Type II
+325 Mesh (%)	7.[illegible]	7.5
Blaine (cm^2/g)	3300	3147
Phase Compounds (%)		
C_3S	41.6	35.3
C_2S	32.9	42.6
C_3A	11.9	4.4
C_4AF	6.7	11.4
	93.1	93.7

f) Laboratory:

The centrally located plant laboratory runs the following tests on a routine basis:

1) pipe density
2) pipe water absorption
3) pipe alkalinity
4) slurry wet bulk

In addition the laboratory facilities are used to run coupling "O" ring tension tests and miscellaneous bench tests on fiber and slurry mixes.

The laboratory is equipped with the Turner & Newall Wet Classifier, the Turner & Newall Surface Area Tester, a Ro-Tap dry sifter and a modified strength unit test.

It was suggested that they equip the laboratory with the Bauer McNett Wet Classifier and the Dyckerhoff Air Permeability apparatus.

g) Water Circulation:

The Capco plant uses a closed system of water circulation, the heart of which is two large cylindrical settling tanks, each approximately 3 feet in diameter and 50 feet high. These "Eve-alls" are positioned so that one overflows into the other. The second tank, containing the cleanest water with a pH of about 12, supplies the koller-gang, turbopulper and the felt cleaning circuits.

Water with the greatest amount of fines is the discharge from the cylinder vats. This is pumped into a hydroclone, the coarse fraction of which is returned to the slurry feed box and the clarified water pumped to the first of the cylindrical settling tanks.

Settled solids from the first settling tank are directed to the trough feeding the cylinder vats.

Periodically, make-up water is added to the system, generally to the settling tanks and during a week-end shut down.

7) Remarks

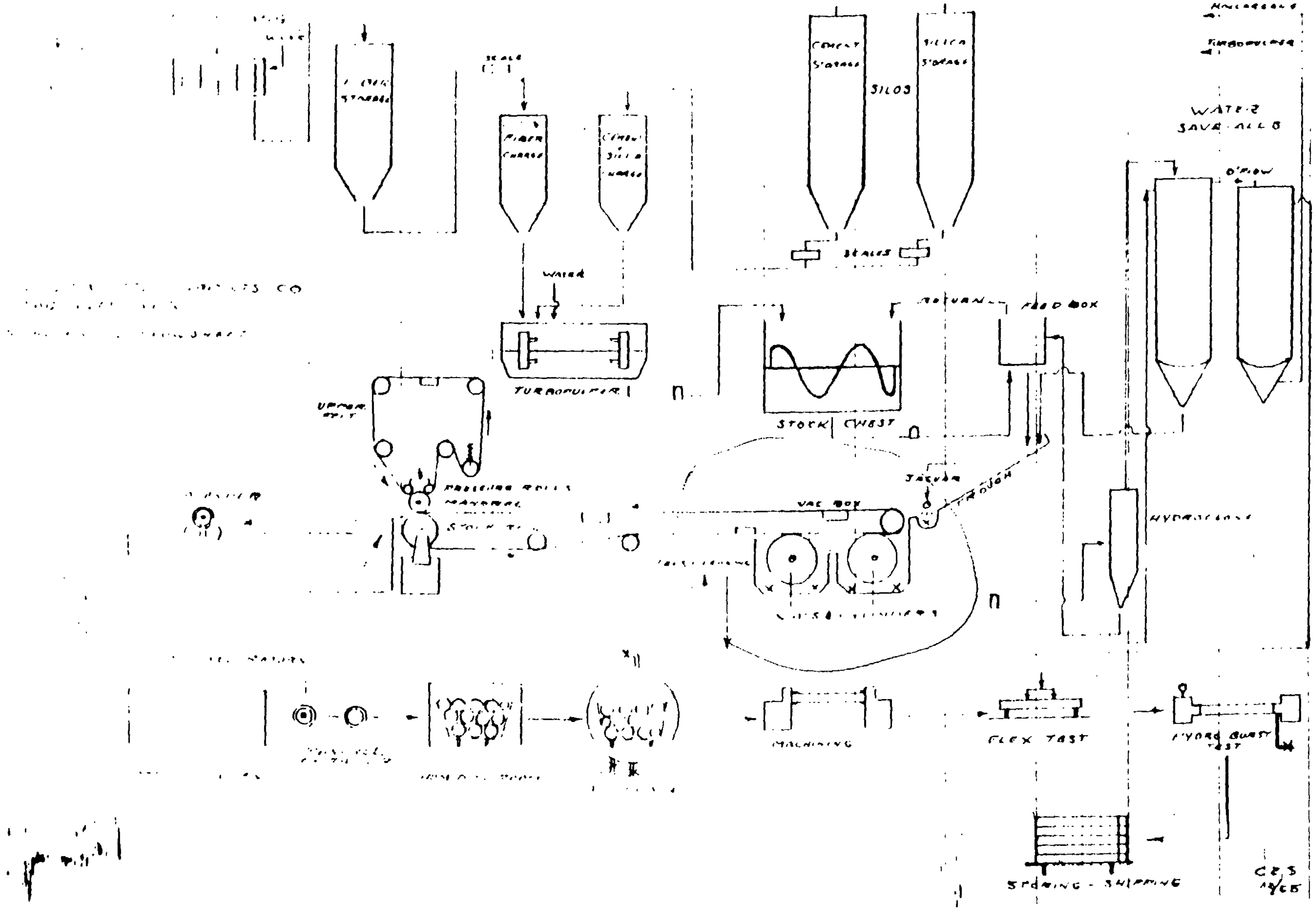
The above observations were made possible through the excellent cooperation and courtesy of the entire Capco plant staff.

An interesting side light of the visit was a tour of the lime and slate quarry and the cement plant of the National Cement Co.

In discussions with the Capco staff it was indicated that the present fiber blends, although satisfactory, will require further revision. Fiber blend experimentation with replacement of [illegible] with [illegible] and inclusion of [illegible] is to be made. The addition of amosite will also be investigated. In this regard the Research Laboratory has been placed at Capco's disposal and welcomes an opportunity to continue to be of assistance.

C. E. Stiefman

CES:[illegible]
Enc.


CEMENT STORAGE
SILICA STORAGE
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SCALES
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TURBOPULPER
STOCK CHEST
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FEED BOX
TROUGH
VAC BOX
UPPER FELT
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