

Johns-Manville Research Laboratory
Manville, New Jersey

MANUFACTURE OF PX FIBER MINERAL WOOL
9TH PROGRESS REPORT - CONSTRUCTION AND INITIAL OPERATION OF
NO. 5 PX FELTING CHAMBER, RICHMOND FACTORY

Report No. 435-95
Problem No. 3-LP-026
October 15, 1947

37-66✓



I SUMMARY

On July 1, 1947 tests were started on the Richmond No. 5 unit, after a three weeks' alteration period, during which it was changed from the fiberizing method employing two steam jets to a four rotor fiberizing technique employing a twenty-foot long down-draft collection chamber.

This was the first complete felting process thus arranged.

The process became a three-shift operation on the third day. On the fourth day, Monday, July 7, a five-day week basis of Superfelt production was begun. On July 14, the factory took over the unit on a thirty-day interim trial basis.

174,968 square feet of Full Thik Superfelt batts were packed, eight deep, in bags, at an approximate density of 2.7 lbs per cu ft, at 3-1/2 inch thickness, during the first five days of operation.

As at Alexandria, blanket density was brought within plus or minus 10% variation from the mean by use of gaseous blast through the panel below the opening into the chamber.

Cured blanket trim was successfully returned to the chamber for the first time in the PX process.

This was the first PX machine employing the in-line cupola breast. It presented an advantage from the standpoints of ease and economy of conversion. Lateral division of the chamber suction box made possible positive control of fiber deposition, during the early experiments.

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I SUMMARY

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II DETAILS OF INVESTIGATION

A. Introduction

Based upon the results of the work at Alexandria factory, it was decided to abandon the drum collection method employed on the Richmond No. 1 unit, and to employ the chamber collection method for PX fibers on the Richmond No. 5 unit.

The latter unit was converted from two-steam jet fiberization to 4-rotor fiberization in a three week period, and the first two weeks of July were used to bring the new technique along to a production basis.

Previous reports on the manufacture of PX wool are as follows: 435-74, 435-73, 32-513, 32-451, 32-421, 32-397, 32-383, and 32-371.

B. Construction of Felting Chamber

(1) Description of Original Blow Chamber

Use of No. 5 unit, as batt producing equipment, by the steam fiberization technique, was discontinued during the week ending June 15, 1947. The unit consisted of a conventional 54 inch cupola, with two steam jets; a 65 ft by approximately 25 ft high down-draft blow chamber; a No. 4-1/2W Clarage chamber exhaustor with a 75 HP, 1200 rpm motor; a new 4-pass, 72 ft oven capable of curing six inch thick material.

(2) Construction Log of No. 5 Felting Chamber PX Unit

The existing equipment was to be altered as outlined in W. M. MacAlpine's letter of June 3 to H. J. O'Brien. The chamber was to be 20 ft long. The rotor assembly elevation would have to conform to plant layout to some extent. Chamber suction would be sectionalized. In general, the design was to follow that of No. 11 PX unit at Alexandria Factory. Appendices E, F, and G show the construction of No. 5 PX felting chamber.

The chamber was shortened to 20 feet, retaining the original height. The suction box was zoned into three longitudinal parts and twice laterally. The cupola was raised two feet, retaining its centerline position, and its straight-away breast position. A 10 x 4-1/2 in. I beam was erected above the breast, closely paralleling the end of the chamber wall, for suspension work. Raising of the cupola brought the steam main uncomfortably close to the top of the breast. The steam condensate line, (later relocated) was actually at breast level. See Sketch, Appendix E.

The chamber flights were installed with three lateral divisions each, to conform with the longitudinal sectionalizing of the chamber. Although these flights had 63 inches of perforations for a 64 inch chamber interior, reinforcing bottom plates blocked off one inch of holes in each end, leaving an effective perforated width of only 61 inches. These holes were oval and 3/16 x 3/4 in.

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The rotor assembly was removed from the No. 1 PX unit, as an expedient. The rotors were mounted identically with the ones used previously during the Richmond No. 1 PX trials. Rotor No. 1 was slightly concaved, had diameters of 6-15/16 and 7-1/32 in., was 1-3/8 in. thick, and turned at 2035 rpm. Rotor No. 2 was flat-faced with an 8-15/16 in. diameter, 1-3/4 in. thickness, and 3090 rpm. Rotor No. 3 had diameters of 11-13/16 and 12-1/16 in., thickness of 2-1/2 in., and 3470 rpm. Rotor No. 4 had diameters of 12-1/16 and 12-3/8 in., thickness of 2-1/2 in., and 4460 rpm. All rotors were of mild steel composition. A chamber seal roll drive was installed. A concrete block was poured to receive the rotor column. Structural work for rotor pivotal column was built on the block. The rear wall housing was lengthened.

The column with a lengthened arm from No. 1 unit was erected. A catwalk was made about the chamber, and observation ports cut. Reinforced concrete was laid below the cupola, and walk ways for the operator were constructed. The rotor assembly was swung into position. A horizontal augur was constructed. A 16 ft inclined augur was procured from a quarry in Northern Indiana and mounted to deliver from the pit. Duct work was joined between the chamber suction box and the plenum. Binder lines and sprays were arranged and water condensate was piped to rotors 3 and 4. Air vents were cut in the rear wall housing. A water-cooled threshold was fabricated and positioned, with water-cooling lines attached. A spare cupola blower was mounted to handle air through the panel under the threshold. The exhaust stack was vented to the atmosphere, by disconnecting it from the common roof duct, leaving a 10 sq ft opening. Water lines were arranged. A metal shield was erected over the tail section of the chamber conveyor to keep water from dripping onto the flights. The unit was hooked up electrically. A trim return line was extended to enter high into the east or exit end of the chamber, as it had in the previous No. 5 arrangement.

The photographs of Appendix B show various sections of the converted suction felting chamber.

C. Log of Initial Operations

Trial No. 1.

No. 5 PX unit was started late in the forenoon of July 1. The rotors were new and slipped slag at first. Suction was limited to 60% of the stack opening. CBX binder was used, with 60% linseed, 20% Pentolyn G, 20% Polypale ester. Blanket formed well with slight heaviness on north edge and $\pm$ 9% density variance in four widths of 15 x 48 Ful Thik. The suction pattern was rearranged by dampering, and the stack was opened to 65%. Ful Thik Superfelt was packed eight deep at about 33 lbs. There was a slight tendency toward build-up over the threshold. The flow of slag was rather viscous. Electrical trouble developed with rotors 1 and 2, causing shutdowns and a termination of the run at 6:30 pm. Binder averaged 1.8%. Density limits were tentatively set at 2.5 to 4.5 lb per cu ft. Shot was 17% on the 48 mesh. Production was 50 packages 15 x 48 Ful Thik and 99 packages 15 x 23 Ful Thik or 5,795 sq ft.

Trial No. 2

The banked cupola was started with difficulty at 12:45 noon. It ran cold. Charge used was 1200 lbs with 240 lb Coke, 500 lb Hamilton, 325 lb Monsanto, 325 lb Alton, 200 lb iron ore. Had considerable trouble positioning the slag stream because the spout was unwieldy. Conveyor speed was about 9-1/2 fpm. Exhaust stack was opened 100% for the remainder of the trials. This run was concluded at 6:30 pm, when rotors 1 and 2 stopped. There was some build-up over the threshold. Production: 7 to 3 shift - 59 bags, 15 x 23 Ful Thik; 3 to 11 shift - 91 bags, 15 x 23 Ful Thik, or a total of 5,749 sq ft.

Trial No. 3

Noted density variance of $\pm 4.5\%$ on the 3 to 11 shift; by zoning differently we were able to favor the north blanket edge with additional weight. The south edge was the weaker from thence onward. There were 1-1/2 hours lost with rotor electrical trouble and chamber drive repair. On the 11 to 7 shift, 1-1/2 hours were lost draining the cupola and repairing a charge bucket. The trial was concluded at about 4:30 am when No. 3 rotor developed a serious surface groove. Binder averaged 2.7%. Shot averaged 12% on 48 mesh. Packages averaged about 34 lbs.

Production was:	7-3 shift	108
	3-11 shift	272
	11-7 shift	187
		567 bags 15 x 23 Ful Thik or
		21,735 sq ft.

Slight alterations were made during the weekend shutdown.

1. Put on additional joint in slag spout arm to give greater maneuverability.
2. Raised position of horizontal binder sprays so that there was less wetting of the threshold by binder.
3. Made 4-1/2 in. air slot extend 2 in. further south to give more air over that threshold corner.
4. Cut a 1/2 in. wide vertical slot in the south curvature of the rotor housing, from the threshold up 2 ft. This was closed July 5.
5. The chamber port, at the inner or diaphragm wall, was moved 3 in. westward, closer to the rotors, to obtain sharper velocity over the threshold.
6. A deflection paddle was hinged from overhead the chamber opening to deflect the falling stream of slag inside the housing, while the cupola was slagging.
7. Replaced rotors 1 and 3 because they had eroded deeply.
8. Dropped the cupola bottom.

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Trial No. 4.

Could not produce on the first shift because the paper backing adhesive was too viscous. Beginning the second shift, the batt density requirement was cut to 2-1/2 lb per cu ft. Density checks across the felt showed variations of +8-11%, +7-14%, +12-7%. Operated 6-1/2 hours when the asphalt again ran dry. Cupola charge was 420 Hamilton, 300 Monsanto, 180 Alton, 120 Gravel, 180 Ore, and 225 Coke. Slag was very viscous and

the melt rate averaged low at 1550 lb per hour. On the last shift, the binder averaged 1.9% and shot 10%.

Day's production: 3-11 shift 165
 11-7 shift 340
 505 pkgs. 15 x 23 Ful Thik or
 19,358 sq ft.

Trial No. 5

There was some build-up at the chamber entrance, causing shot clusters and binder variations. On the first shift, binder averaged 4% and shot 16.7%.

On the second shift, binder averaged 2.3%, shot 19%. A broken drive chain cost one hour of production.

On the third shift, the solubility was 3.2 cc using 420 Hamilton, 300 Monsanto, 180 Alton, 180 Ore, 120 Gravel, and 225 Coke. Asphalt trouble cost one-half hour.

Production: 7-3 shift 270
 3-11 shift 330
 11-7 shift 379
 979 pkgs. of 15 x 23 Ful Thik or
 37,526 sq ft.

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Weight Variation of 29 consecutive cuts of 15 x 23 Ful Thik Superfelt.

Tues.,	South	So. Center	No. Center	North	TOTAL
7/8/47					
1	37 oz.	29 oz.	30 oz.	30 oz.	126 oz.
2	32	28	28	31	119
3	24	28	28	28	108
4	38	34	28	29	129
5	23	25	26	27	101
6	30	25	35	27	117
7	28	24	28	28	98
8	23	26	18	34	101
9	29	25	23	29	106
10	29	28	28	33	118
11	35	26	30	34	125
12	30	25	24	29	108
13	30	26	24	29	109
14	28	28	25	28	109
15	32	23	24	22	101
16	28	26	28	27	109
17	28	32	29	27	116
18	30	28	25	28	111
19	25	27	30	27	109
20	26	28	26	26	106
21	24	25	24	29	102
22	24	25	23	24	96
23	20	23	24	26	93
24	30	26	27	30	113
25	19	21	23	30	93
26	20	21	22	28	91
27	19	20	21	28	88
28	22	26	21	23	92
29	29	24	22	25	100
	792 oz.	752 oz.	734 oz.	815 oz.	3094
Dividing by	29	29	29	29	29
Avg weight-	27 oz.	26 oz.	25 oz.	28 oz.	107 + 4 = 26.7
Avg variance from mean wt, +1.3 oz., -1.7 oz. or +5%, -6.4%.					oz. per batt

Trial No. 6

A 25 lb package of 23 Ful Thik showed a 25 in. cumulative thickness upon opening. The two top batts were 4-1/2 to 3-1/4 in.; 4 to 3-1/4 in. The two bottom batts were 3-3/4 to 3-1/2 in.; 3-1/2 to 3-1/2 in.

The cupola was put down for dropping at 9 am. Binder averaged 2.2%. Solubility was 4.8 cc. Slag viscosity was 7-3/4 in.

A flexible binder line was inserted in front of the threshold but the results were inconclusive.

No. 2 rotor was replaced, and number 3 showed signs of grooving.

Resumed production at 7 pm. Shot averaged 16.7%. Slag viscosity was reported at 11-1/4 in. Solubility was 4.3 cc.

On the third shift a jack shaft on the oven drive broke, because wet shot had overflowed the slag augur casing and bound the chain.

Production:	7-3 shift	109
	3-11 shift	226
	11-7 shift	<u>141</u>
		476 pkgs. of 15 x 23 Ful Thik or
		18,247 sq ft.

Trial No. 7

Operation was resumed shortly after noon. Cupola charge was 420 Hamilton, 300 Monsanto, 180 Alton, 120 Gravel, 180 Ore, 225 Coke. There was excessive shot in spots. Binder averaged 2.1%.

Production:	7-3 shift	117
	3-11 shift	408
	11-7 shift	<u>330</u>
		855 pkgs. of Ful Thik or 32,880 sq ft.

Trial No. 8

Melt rate for the first two shifts was 2550 lbs per hour. Operation ended about midway of the third shift.

Production:	7-3 shift	368
	3-11 shift	390
	11-7 shift	<u>119</u>
		877 pkgs. 15 x 23 Ful Thik or
		33,678 sq ft.

A 30-day interim production period was set to begin on July 14.

D. Journal Reference

Notebook No. MW-226, pages 3 to 44 inclusive, for the period 6/17/47 to 7/12/47.

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III SUMMARY AND FUTURE WORK

1. The chamber exhauster handled 35,000 cfm of 140 to 150°F gases to the atmosphere.
2. Binder was applied by steam atomization through Hauck needle valves and spray nozzles as at Alexandria. When the binder content surpassed 2.5%, the gases appeared to create a neighborhood nuisance.
3. At Alexandria, a blast of steam through the panel under the chamber threshold had solved the problem of felt distribution. At Richmond, air was successfully substituted for steam through the panel below the threshold. A spare 1200 cfm cupola blower was used and again, when this blast was properly directed, it proved critical to the good felting of fibers.
4. The batt trim problem was solved on this unit employing regular oven practice by delivery through a 9 in. pipe, about 125 ft into the east end of the chamber. The trim blower was a No. 15 Clarage with pressures across the fan of 5-1/2 in. of water.
5. Air currents over the threshold surface were not as sharp as at Alexandria, due possibly to the sunken position of the rear wall housing in the pit. This factor deserves more study, since fibers were exhibiting a tendency to group at the entrance on the threshold.
6. A dirty cupola blower caused poor melting rates and viscous slag throughout the eight days of running. Coarse fiber resulted. Standard Superfelt melting rate was not attained.
7. Oven speed was limited to 9-1/2 fpm due to gear ratios, but this was being corrected before the next startup.
8. The straightaway type of cupola breast was given its first trial here and proved difficult to attend, because of the cupola's elevation and because of consistent lack of proper melting temperatures. However, from the standpoint of economy, it may deserve consideration, when converting other units to the PX technique, after longer usage.
9. 2.7 lb per cu ft density batts, at 3-1/2 in. thickness, gave a high quality product. An attempt to make 2.0 lb density showed the top and bottom batts barely meeting the 3-1/2 in. out of package thickness.
10. The finished product was averaging about 15% shot on the 48 mesh, and binder contents of 2.5% were imparting good resilience to the fibers. Binder minimum will probably be limited by the water repellancy of the baked batt, and this quality will vary directly with the binder content. Heavy return of scrap to the process will cause greater binder usage.

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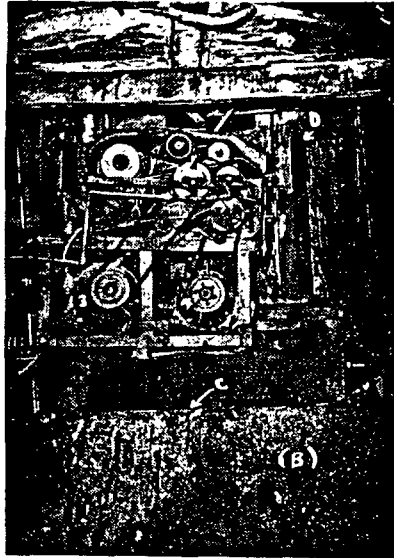
11. The width of chamber flight perforations was insufficient to assure full blanket edges. Further flight design should include 63 in. wide perforated area.
12. Lateral subdivision of the chamber suction box gave positive results as regarded shifting blanket density from one area to another.
13. Future work.
 - a. The factory will operate the unit on an interim agreement to gain experience and determine weaknesses and deficiencies in the construction and layout.
 - b. Revisions in air flow pattern will be made as developed by further research.
 - c. Rotor wear will be observed and other alloys tested.

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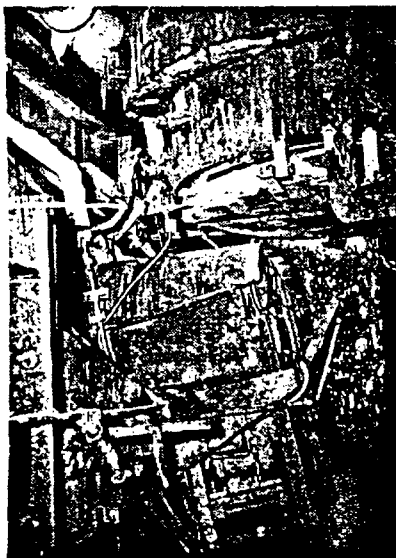
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IV APPENDIX A - Two Photographs of Rotor Assembly



Photograph No. 1

No. 5 FX Unit, Richmond. Rotor assembly in operating position, protruding through the rear wall of the rotor housing. Cupola bottom (A) shows at the top of the picture. Three motor drive (1) drives rotors 1 and 2; (3) drives rotor 3; (4) drives rotor 4. The slanted, reinforced floor (B) is at the bottom. Horizontal air slot (C) and vertical air slot (D) show more clearly in Sketch, Appendix G.



Photograph No. 2

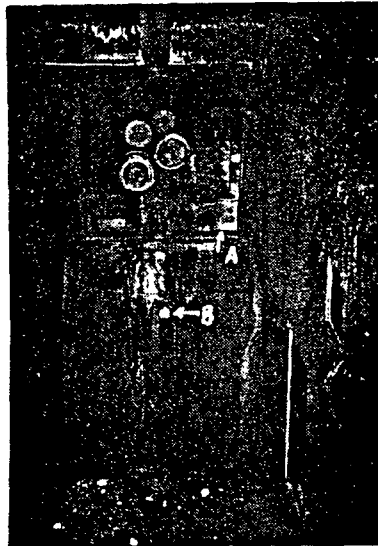
No. 5 FX Unit, Richmond. Looking southeast at rotor assembly in running position. Slag spout (A) shows a 45° angle. (This was made level in late July, 1947)

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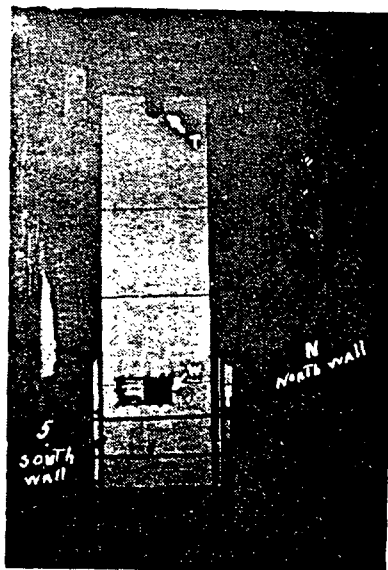
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IV APPENDIX B - Five Photographs of Felting Chamber



Photograph No. 1

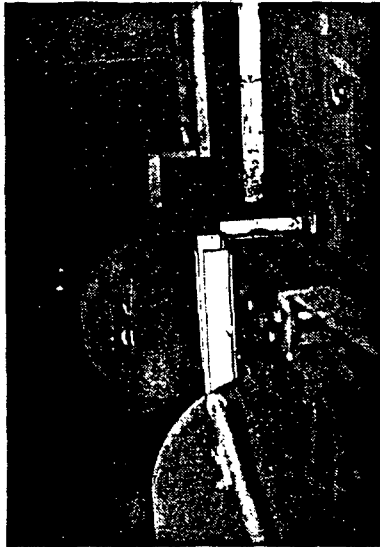
No. 5 PX Unit, Richmond. Looking west from rear window of collection chamber at the rotors in position to operate. Note the top curvature of the threshold (A) below the rotors, and still lower, the inlet (B) of the auxiliary air blast.



Photograph No. 2

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No. 5 PX Unit, Richmond. Looking west at the discharge end of the collection chamber, from near the oven entrance. Note the walls (N), (S) of the 45 ft of unused blow chamber, the rear chamber window (W), and the trim return line (T) entering high into the discharge end of the chamber.



Photograph No. 3

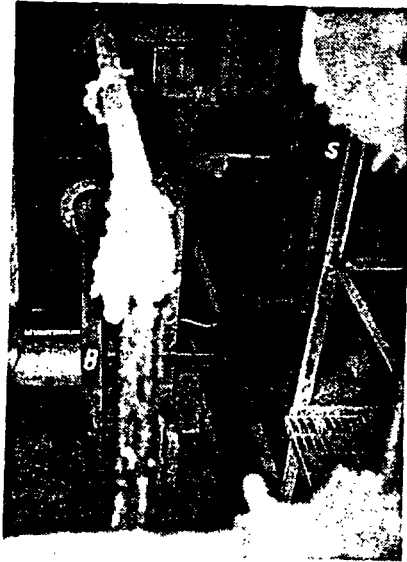
No. 5 PX Unit, Richmond. View of exterior of lower, south chamber wall (S). This shows how the ducts (D-1) emerge from two of the six zones of the suction box and curve underneath into the plenum chamber.



Photograph No. 4

No. 5 PX Unit, Richmond. Another view of lower, northwest corner. This shows a suction duct (D-1), the tail shaft of the conveyor (S), and the 16 ft inclined shot augur (A). Water has overflowed the augur casing to deposit considerable silt into the pit.

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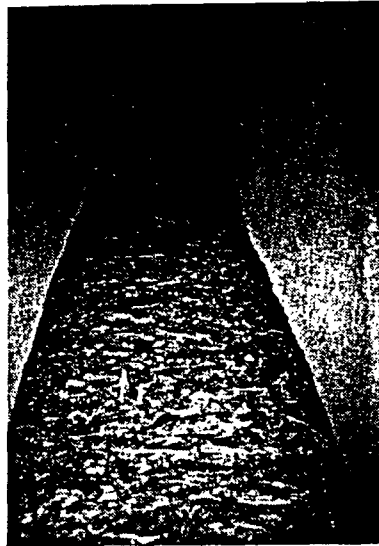
Photograph No. 5

No. 5 PX Unit, Richmond. Looking west along the exterior south wall (S) of the collection chamber. Note the auxiliary air blast blower (B), mounted to discharge into the west end of the chamber after making two 90° turns.

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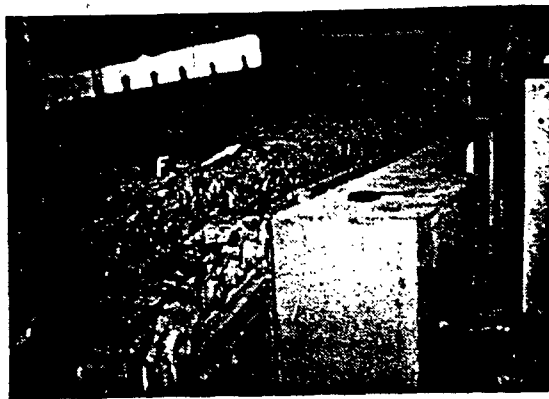
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IV APPENDIX C - Three Photographs of the Uncured Felt



Photograph No. 1

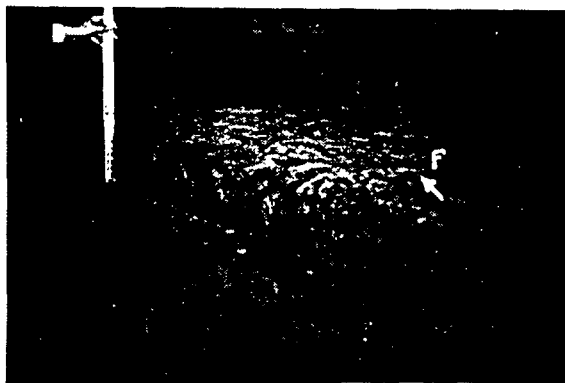
No. 5 PX Unit, Richmond. Looking east, from the catwalk, at the discharge end of the collection chamber, downward at the uncured felt (F) traveling toward the oven through the unused 45 ft of the original blow chamber.



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Photograph No. 2

No. 5 PX Unit, Richmond. Looking northeast across the uncured felt (F) as it enters the oven.



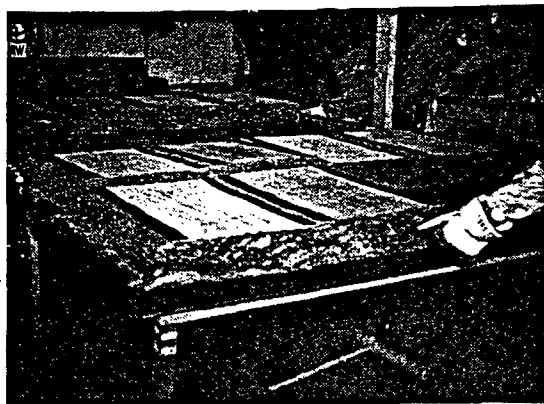
Photograph No. 3

No. 5 PX Unit, Richmond. Looking southeast,
across the 8 in. uncured felt (F) as it enters
the oven.

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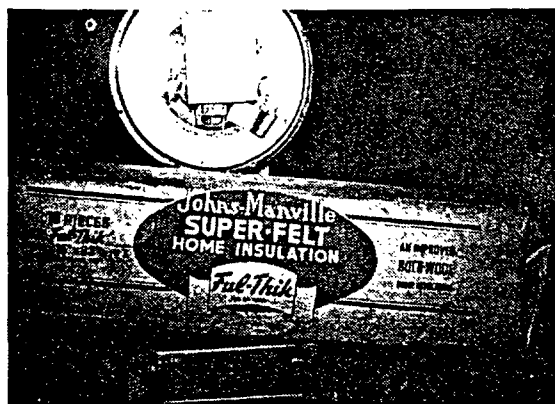
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IV APPENDIX D - Two Photographs of the Baked Felt



Photograph No. 1

No. 5 PX Unit, Richmond. 15 x 23 Ful Thik Superfelt
on the take-off table."



Photograph No. 2

No. 5 PX Unit, Richmond. A 33 lb package of Ful Thik
Superfelt crossing the scale.

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