PLAINTIFF'S EXHIBIT

GP-717

CERTAIN-TEED PRODUCTS CORPORATION

Ardmore | January 9, 1956 | Paoli Laboratory

Mr. O. F. Grieve

AGENDA 1956
GYPSUM PLANT MANAGERS MEETING

C. G. Shuttleworth - mjs

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cc: Mr. P. E. Fischer, V. P. - Ardmore
Mr. G. A. Hoggatt - Paoli Lab.
Mr. H. J. Zelms - Acme
Mr. H. F. Debo - Akron
Mr. K. W. Brown - Blue Rapids
Mr. Myron Read - Fort Dodge
Mr. A. H. TenElshof - Grand Rapids
Mr. E. L. Flinn - Sigurd
Mr. J. W. Hart - Pryor
Mr. M. M. Powers - Akron
Mr. P. W. Codwise - Thorold
Mr. H. C. Johnson - Paoli Eng.
Mr. W. G. Will - Paoli
Mr. H. C. Puckett - Fort Dodge
Mr. M. F. Fink - Ardmore

In compliance with the requests in the third and fifth paragraphs of your letter of December 12, 1955, I have prepared a paper on assigned topic No. 17 and a copy of it is attached to each copy of this letter.

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BOARD AND LATH DRYING

The subject of drying gypsum wallboard and lath products is a rather controversial one and not yet entirely understood. However, there is certain data available to us from actual performance of our own dryers and from the study made of the Grand Rapids dryer in 1954 by Foster D. Snell.

Herewith is a summary of data from our five plants showing operating speeds, dryer temperatures, and drying time in minutes for the three major board and lath products.

TEMPERATURES BY SECTION, ENTERING AIR

PLANT	MATERIAL	1	2	3	4	5	6	DRYING TIME IN MINUTES
Acme	3/8 lath	465	460	475	355	370	225	60.5
Fort Dodge	3/8 lath	460	440	380	270	240		51
Akron	3/8 lath	300	295					56
Grand Rapids	3/8 lath	300	318	305	279			58
Sigurd	3/8 lath	295	295	260				60
Acme	3/8 bd.	500	500	490	400	370	190	56
Fort Dodge	3/8 bd.	450	430	360	250	200		59
Akron	3/8 bd.	300	295					60
Grand Rapids	3/8 bd.	300	318	278	284			65
Sigurd	3/8 bd.	295	305	260				67
Acme	1/2 bd.	485	510	485	415	450	210	73
Fort Dodge	1/2 bd.	460	440	380	270	240		74
Akron	1/2 bd.	300	295					80
Grand Rapids	1/2 bd.	300	318	278	284			89
Sigurd	1/2 bd.	300	305	260				80

Note: Production rates of lath at Acme and Sigurd is said to be governed by facilities at take off rather than by ability of the kiln to dry the lath.

This shows that the gas fired kilns are drying at faster rates than the steam kilns, no doubt due to the higher temperatures available during the constant drying rate period. Study of the penetrometer test reports shows that end and edge calcination are not markedly different at the five plants. Of the steam plants, Akron dries all three products as fast as or faster than at either Grand Rapids or Sigurd in spite of the fact that it has 150 lb. steam available as against 200 lbs. at the other two. The reason for the good performance is not altogether clear but may be partially due to the somewhat lower evaporation normally obtained at Akron.

In general, the Grand Rapids dryer is the least efficient of any which led to the study made by Foster D. Snell in 1954. This was a rather thorough study which amassed a large volume of data, some of which appears to be contradictory, but some of the more pertinent conclusions from the pilot plant study are as follows:

1. The characteristic drying rate curve for homogeneous materials is divided into three parts. The first is a rising curve as the product is warmed up to its maximum temperature. The second part is a flat plateau of constant drying rate versus time. The third is the falling rate period from the critical moisture content to dry, the drying rate versus time sloping downward as the product becomes more dry.
2. At temperatures of 258° to 264° F, there is no significant change in rate of drying during the constant rate period which can be attributed to the moisture content of the drying air.

3. The type of cover paper on the product has a significant effect upon the constant drying rate. Papers which transmit moisture from the core to the surface faster have a faster drying rate. No information as to which characteristics of the paper are critical was determined.

   At high drying temperatures, the rate of water transfer through the cover paper is less than the rate at which it can be carried away by the air. The paper resistance then becomes the limiting factor during much of the drying period.

4. The rate of drying at and adjacent to the ends and edges is greater than in the centers of the board and laths.

5. The critical moisture content at which the falling rate begins is approximately 25% based on the dry weight. At Grand Rapids, this coincides roughly with the fourth section.

6. Since the air leaving the kiln will have a high heat content, economy dictates the recirculation of a large portion of the moisture laden air. The water vapor obtained from the board or lath continually increases the volume of the humid air and therefore a portion must be continuously exhausted to maintain a balance in the kiln.

7. The pick up capacity of the air above 260° F increases with air humidity, the degree of the air recirculation is therefore limited only by the overall heat economy of the dryer.

8. The rate of actual moisture pick up of the air is governed by the following factors during the constant rate period.

   a. The internal resistance of the core. This is least important.

   b. The resistance of the paper covers.

   c. The resistance of the air film at the paper inter-face. This resistance is a function of the air velocity, the lower the velocity the greater the resistance.

Although it has been shown that the resistance of the paper covering is higher than that of the core, it is evident that the air film has been the major controlling factor.

Study of the operation of Grand Rapids kiln led to the following conclusions:

1. The kiln is operating at maximum efficiency for the air flows now available and air velocities are low.
2. The controlling factor in the drying rate in at least the first three sections is the rate of moisture pick up by the air stream. This suggests an increase in air velocity in these three sections.
3. Any significant increase in kiln capacity for drying 3/8 lath, would require additional heat, that is; more boiler capacity.

Note: The full capacity of the large boiler is used only on 3/8 lath. A small boiler is available on a stand by basis.

A recent study of drying times at Grand Rapids against those at Akron and Sigurd indicates that if the former kiln could be made as efficient as the latter two, then Grand Rapids could make about 8,000,000 sq. ft. more board and lath per year than they are now doing. A further study is now underway to determine if such a program is advisable. The contemplated changes are larger fans and ducts in the first three sections so as to increase the air velocity in the kiln and thereby the rate of pick up by the air. Air velocities in the first two sections according to Snell are about 1,000 to 1,250 ft. per minute, whereas, in the third section it is only about 500 to 700 ft. per minute. If these figures are correct, it would appear to me that the third section would be the one to change first since the low air velocity in this section causes a low drying rate.

Before making a final decision on what to do at Grand Rapids, it seems to me that we ought to recheck the air velocities in the first three sections to be certain they are correct and then obtain the same data from Sigurd and Akron if it is not already available. With these data at hand, the proper size fans and ducts could be installed to assure optimum air velocities.

The matter of the use of oil fired kilns is outside of my experience but we know that U.S.G. uses such kilns in many of their plants with good results. The design of the combustion chambers would no doubt have to be different and other precautionary measures taken such as neutralizing the sulfurous acid produced by the combustion of the sulphur in the oil. It seems to me that any kilns we build in the future should be direct fired and whether gas or oil is used for fuel would be largely a matter of economics.

Based on the Snell reports, our kilns should possibly be operated as follows:

1. During the constant rate drying period.
   a. Use as high temperatures as possible commensurate with other factors, in order to obtain rapid drying.
   b. Recirculate as much air as possible in order to -
      1. Keep temperatures high.
      2. Assure rapid heat transfer to board.
      3. Keep heat losses down.

Note: Amount of air recirculation, especially in first section, cannot be kept so high as to cause starch spots on the board or blow-off of the paper.

2. During the falling drying rate period, which at Grand Rapids is in

about 43.6% of the length of the kiln, it should be operated as follows:

1. Keep humidity as high as possible to promote rapid high transfer and also keep the calcining temperature of the core as high as possible to reduce end and edge calcination.
2. Gradually lower the temperature to as near 200° F as possible to decrease rate of end and edge calcination.

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