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NATIONAL RESEARCH COUNCIL OF CANADA

DIVISION OF BUILDING RESEARCH

No.
253

TECHNICAL NOTE

NOT FOR PUBLICATIONFOR INTERNAL USEPREPARED BY W. WoodsideCHECKED BY A.G.W.APPROVED BY N.B.H.PREPARED FOR P.O. Freeman, Research Dept.,
Siporex Ltd.DATE June 1958SUBJECT Description of First Combined Heat
and Moisture Test on Siporex

Three holes, each $1/16$ inches in diameter, were drilled in a 12 x 12 x 2 in. Siporex sample, and 30-gauge copper-constantan thermocouples installed. The thermocouple junctions were located at the centre axis of the sample, and approximately $\frac{1}{2}$, 1 and $1\frac{1}{2}$ in. respectively from one surface. Thermocouples were also fastened to the centres of the top and bottom surfaces. The instrumented sample was oven-dried and its thermal conductivity determined in a 12-in. guarded hot plate apparatus. Readings of the internal thermocouples were taken during steady-state conditions in the hot plate, enabling the determination of the exact locations of the thermocouple junctions.

The apparatus consisted of a $4\frac{1}{2}$ x $4\frac{1}{2}$ in. bakelite heat flow meter, with 8 x 8 in. bakelite guard ring, attached to the top surface of an 8 x 8 in. hollow metal plate (cold plate). The underside and edges of the plate and the piping between plate and liquid source were covered with a 2 in. thick layer of insulation with polythene film on the outer surfaces.

In order to ensure good thermal contact, a $1/8$ in. thick sheet of foam rubber was interposed between the Siporex sample and the heat meter. The edges of the sample were vapour-sealed with polythene film. Constant temperature liquid at $5.5 \pm 0.25^\circ\text{F}$ was circulated through the plate. The ambient air was controlled to 70°F and 50% relative humidity. The air temperature and relative humidity were recorded on a calibrated hygrothermograph. A general view of the apparatus is shown in Fig. 1.

Daily observations of internal and surface temperatures and heat flux through the sample were made. After one day the top surface temperature reached the dew point and for the remainder of the test was below the dew point.

After 62 days of exposure to the above conditions, cracking and heaving at the centre of the top surface was observed, and the central 8 in. square of the top surface appeared wet. A large ice lens was observed just under the top surface. Three 1 in. diameter cores were removed, sliced into quarters

of approximately $\frac{1}{2}$ in. thickness, and moisture contents determined by weighing and oven-drying. The slab was then broken into smaller pieces and cross-sections examined under a microscope. Several photomicrographs (5X and 20X) of the ice-filled pores and the ice lens were taken. Two such photographs are shown in Figs. 2 and 3.

The temperature profiles and heat flows at various times after the start of the test, and the final moisture content distribution are shown in Fig. 4.

The sheet of foam rubber between the cold plate and Siporex sample also gradually filled up with water during test, thus decreasing its thermal resistance and the temperature drop across it. This accounts for the decrease in Siporex cold surface temperature shown in Fig. 4.



Fig. 1 General view of apparatus, showing test sample at end of test. Also shown are the potentiometer, selector switch, reference ice junction, hygrothermograph and core sampler. (BR 7601)

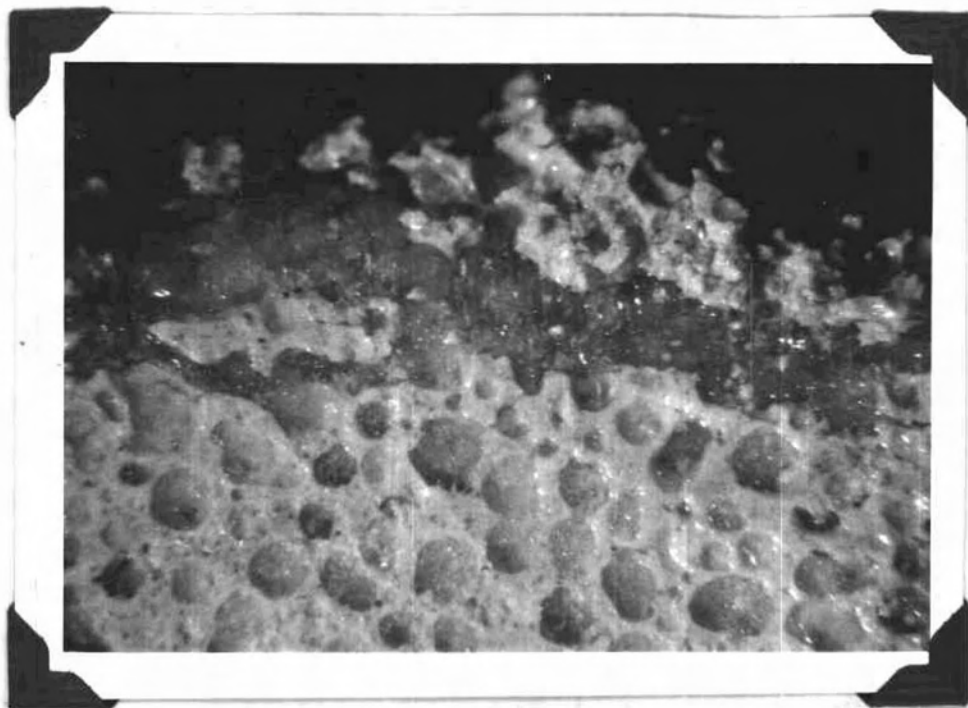


Fig. 2 Photomicrograph of section of sample at end of test, showing ice lens near top surface (magnification 5x) (BS 2)

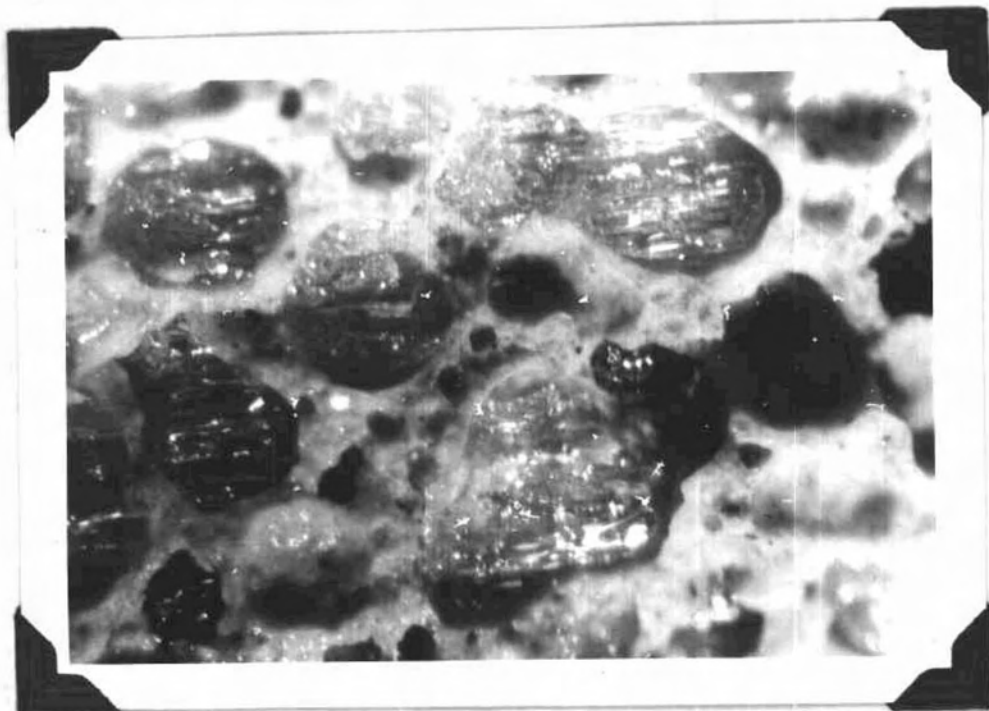


Fig. 3 Photomicrograph showing ice filled pores (magnification 20x) (BS 6)

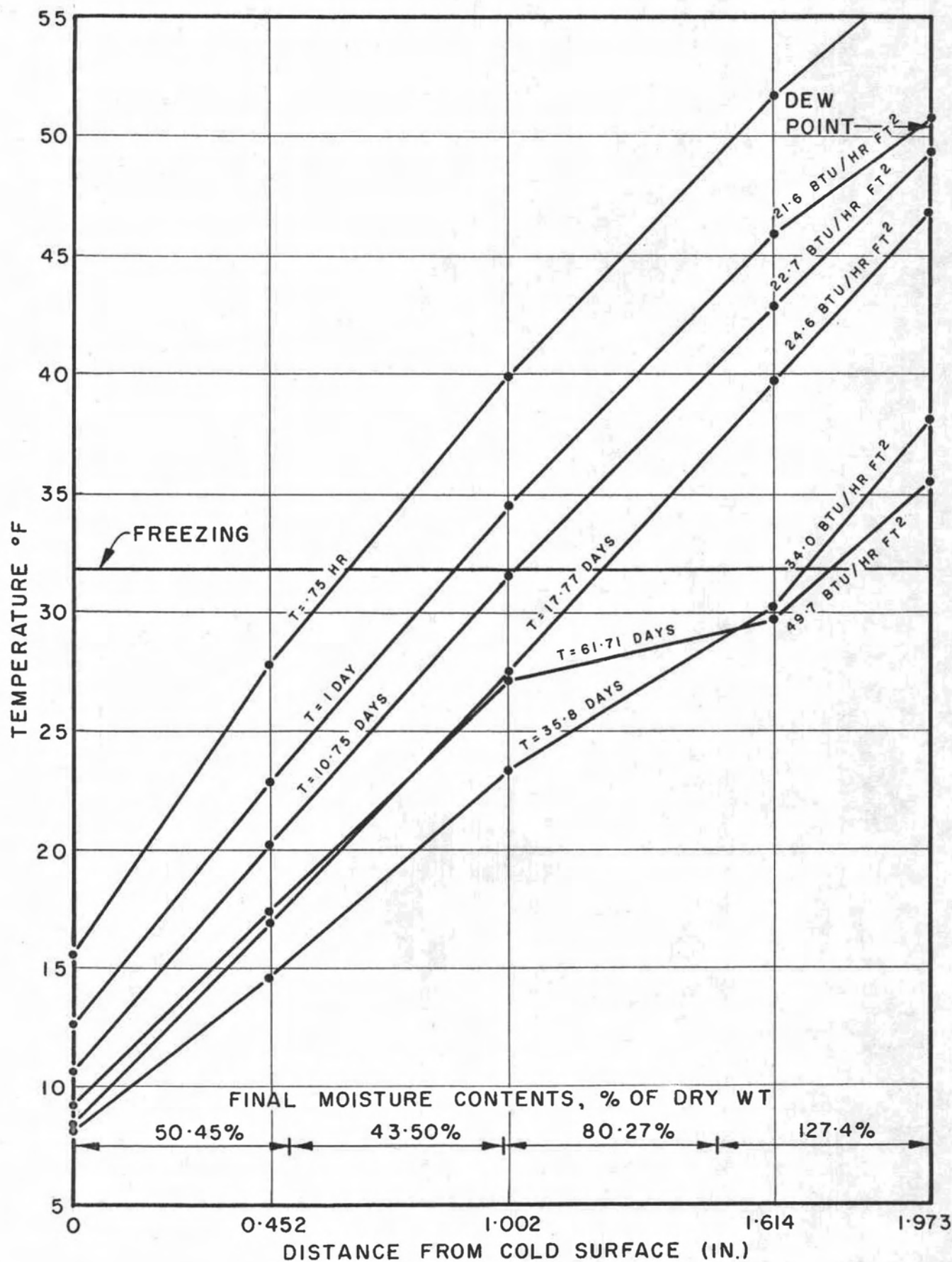


FIGURE 4
TEMPERATURE DISTRIBUTION IN 2" SIPOREX SLAB.