University of
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Report for

Safeguard Europe Ltd

ADVICE ON RISING DAMP TREATMENT

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A Study of the Absorption of Water into Brick and Mortar Samples Treated with Damp Proofing Creams

When a porous building element is in direct contact with the ground, the process of rising damp can occur where water is drawn upwards into the building structure by capillarity. The height of this capillary rise will depend on a number of factors including the pore structure of the building element and the evaporation rate from the surface.

One method of controlling rising damp is to inject silicone based products into the mortar line of brickwork. These products work by diffusing into the porous structure and chemically reacting with the mineral surface to attach hydrophobic groups. The groups then reduce the surface energy inside the capillaries which causes the rising damp boundary to fall - thus reducing dampness.

Background to testing

In 2000 a silicone based solventless cream product called Dryzone was launched with the ability to control rising damp. This contains a high level of material (63% by weight). Since then, alternative products have come on the market at lower cost but with lower amounts of active material (15-20% by weight).

The University were asked to compare the water absorption of brick assemblies that had been treated with high strength and low strength creams.

Damp proofing creams are used to treat older houses which have experienced rising damp problems. The mortar found in such properties is quite often porous and neutral in pH. This is because the alkalinity of the lime or cement has been reduced gradually by the process of carbonation. In these experiments a mortar recipe was chosen with high porosity and neutral pH to replicate this condition.

Sample preparation

Brick assemblies - referred to as "Brick Burgers" - were prepared from a sandwich of two brick slips and wet mortar.

The brick slips were supplied by Hanson PLC. Common fletton brick faces were used of size 215 mm x 65 mm x 16 mm. The mortar used was prepared from plastering sand supplied by a local merchant. This was bound with a neutral pH inorganic binder. The particle size distribution of the sand is given in the Appendix

After the "burger" had been made up, two wooden dowels were inserted into the mortar to form holes that could be used to place the damp proofing creams. The holes were of diameter 12mm and were placed 120 mm apart from centre-to-centre. The wooden dowels were removed within 5 minutes of making the burger. Each burger was then left to cure in air for 28 days at 20C.

Then 5 g of each damp proofing cream was inserted into each hole by using a plastic dropping pipette. The assembly was then left to cure for 28 days

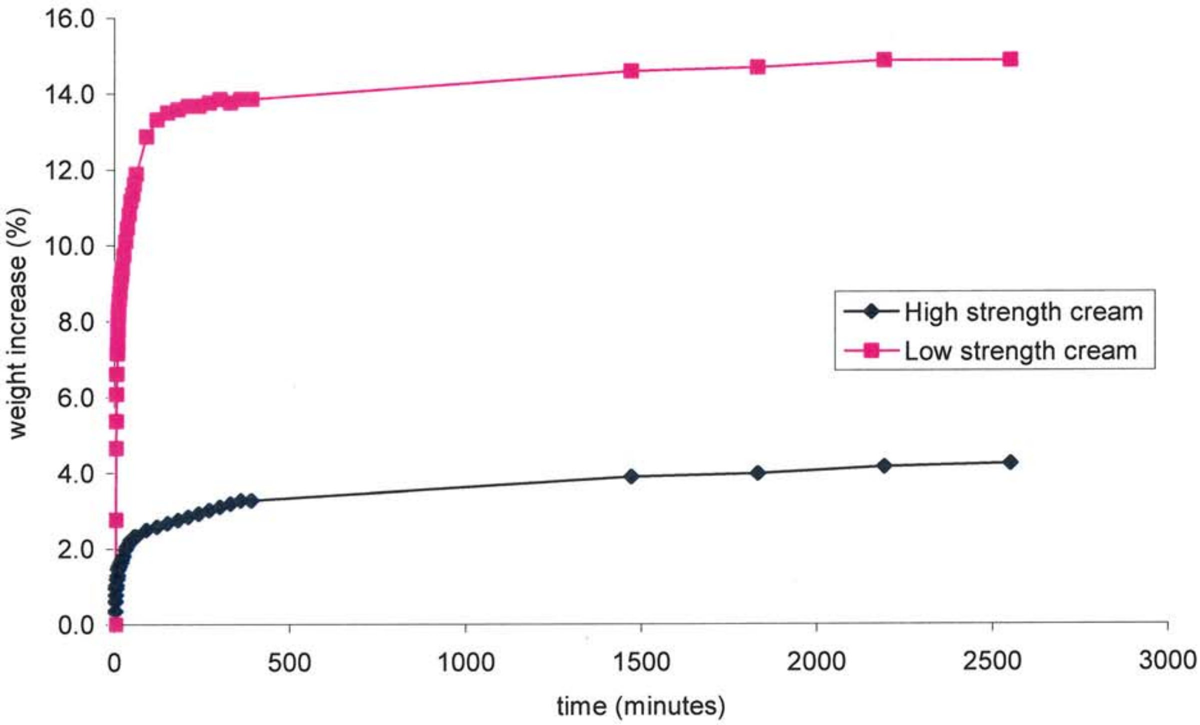
Water absorption testing

The water absorption of the brick burgers was measured by placing a burger in a shallow tray of water of approximately 4 mm depth. The weight gain was measured periodically to give a water absorption graph. In addition, photographs and a time-lapse video were taken to show how the rising damp boundary advanced with time.

Graph

The graph below shows the observed weight gain from burgers made with low and high strength creams. The original weight and time data are shown in Appendix 2.

Figure 1 : Weight gain on contact with water of brick assemblies treated with high and low strength damp proofing creams



Most of the absorption occurs within the first 500 minutes of contact with water. After this point there is a levelling off to a plateau value.

The data shows a clear difference in water absorption behaviour of the high and low strength creams

As the rate of absorption is governed by diffusion of water into the pores, it is worthwhile plotting the data against the square root of time (Fick's Law). This is shown in Appendix 3 where again similar differences are observed. By treating the data in this way it is possible to calculate the diffusion rate coefficients as follows;

D3

Initial Gradient = 2.78

Coefficient of Diffusion, $D = \frac{\pi}{16}\left(\frac{\frac{M_t}{M_\infty}}{\frac{\sqrt{t}}{h}}\right)^2$

= 1.52 mm^2/s

W3

Initial Gradient = 16.42

Coefficient of Diffusion, $D = \frac{\pi}{16}\left(\frac{\frac{M_t}{M_\infty}}{\frac{\sqrt{t}}{h}}\right)^2$

= 52.93 mm^2/s

This coefficient is calculated by measuring the initial gradient from the graph and proportioning by a thickness related term.

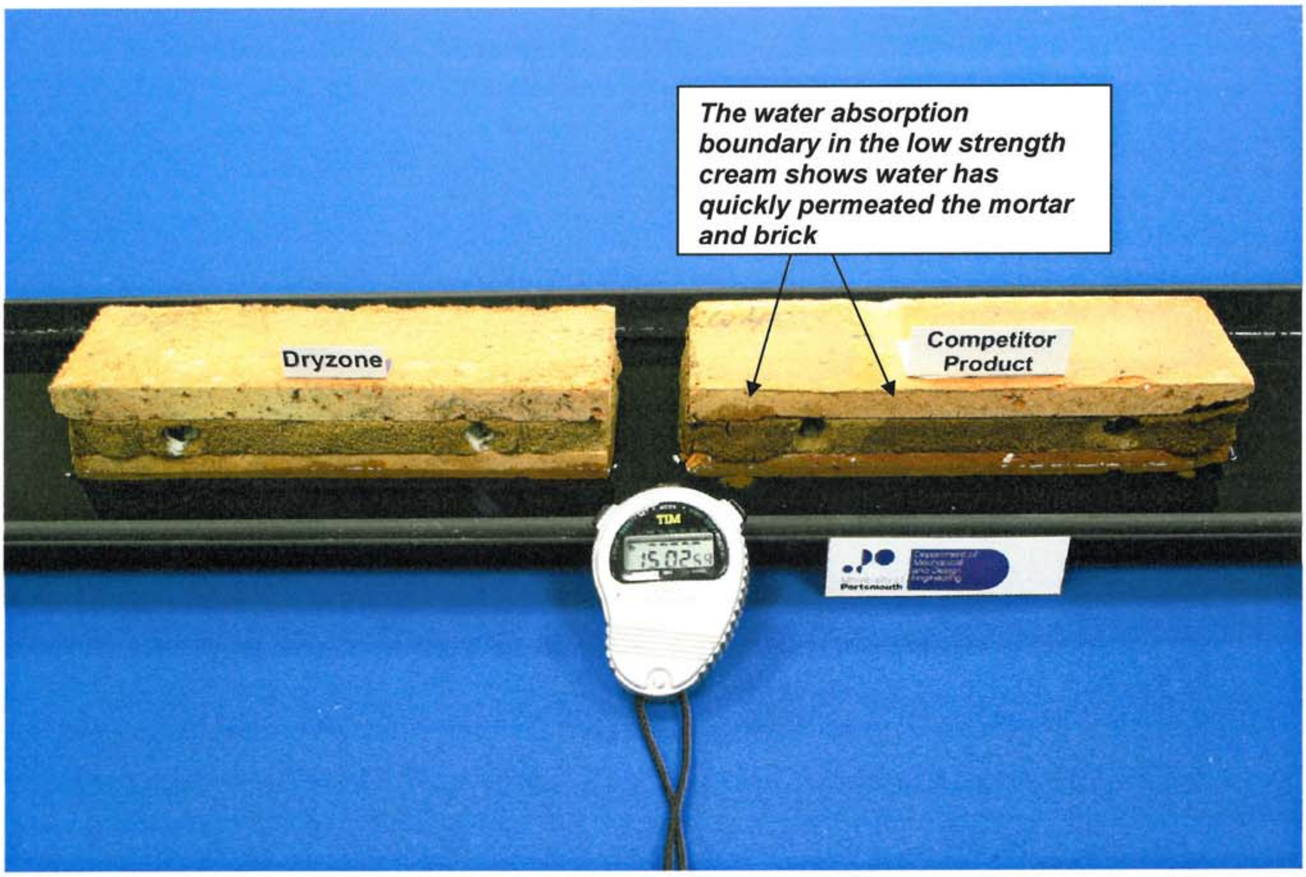
Hence we see that;

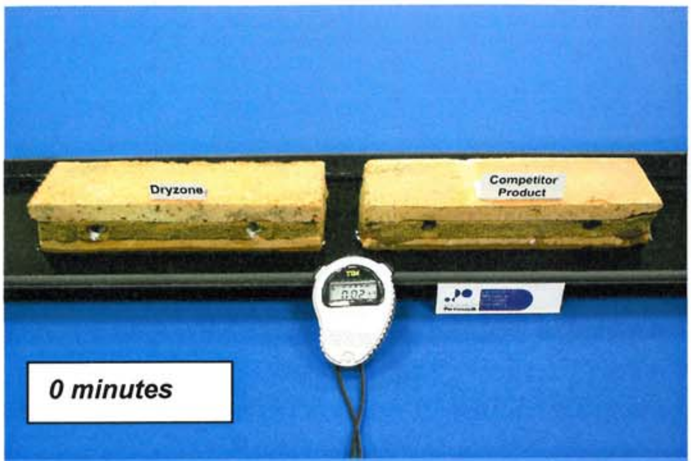
Coefficient of diffusion for high strength cream = 1.52 mm^2/s
Coefficient of diffusion for low strength cream = 52.93 mm^2/s

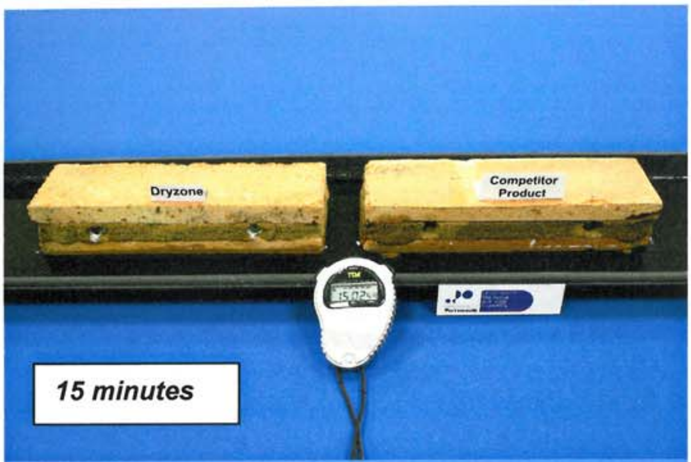
Photographs

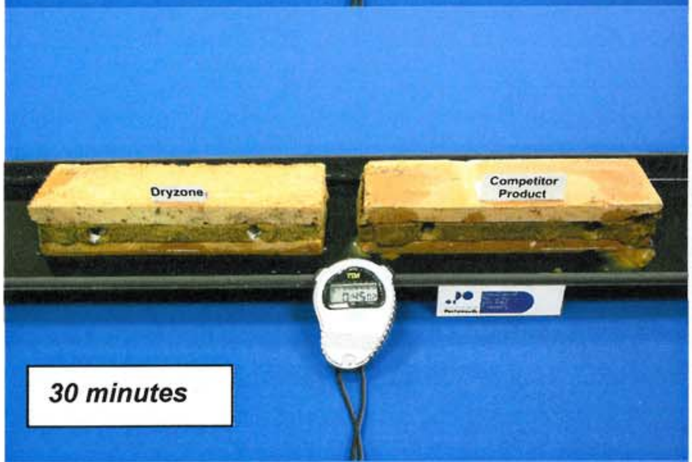
It was possible to watch the advancing rise of water in the brick assemblies. Where water has wetted the brick and mortar surface a darker colour is evident. The pictures on the following page were initially taken at 15 minute intervals and then at longer times. It can be seen that water absorption occurs quickly.

Photograph: Water absorption in the early part of the test

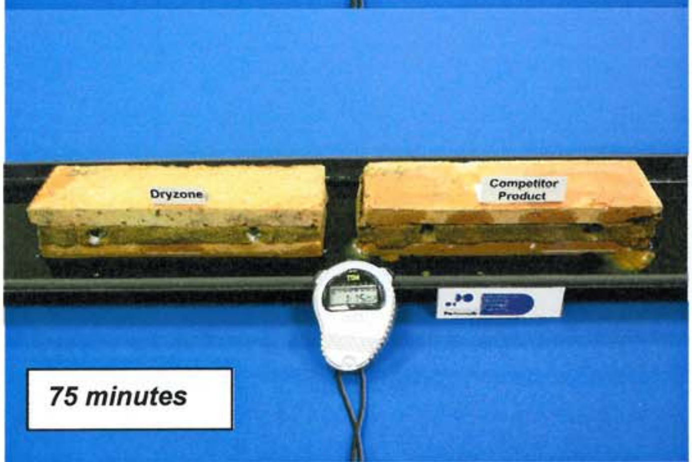



Dryzone
Competitor Product
0 minutes

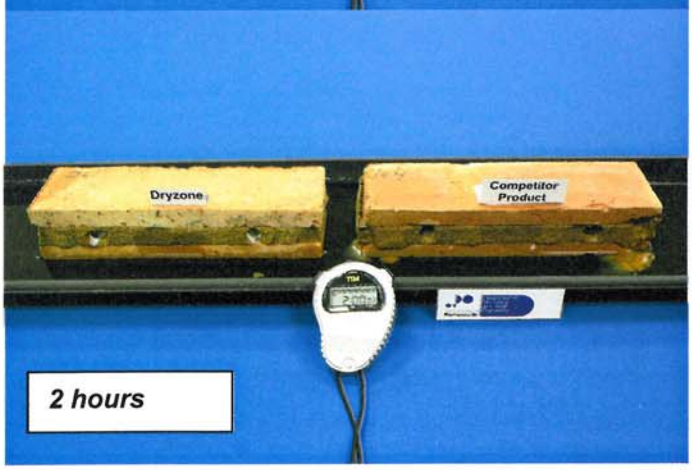

Dryzone
Competitor Product
15 minutes

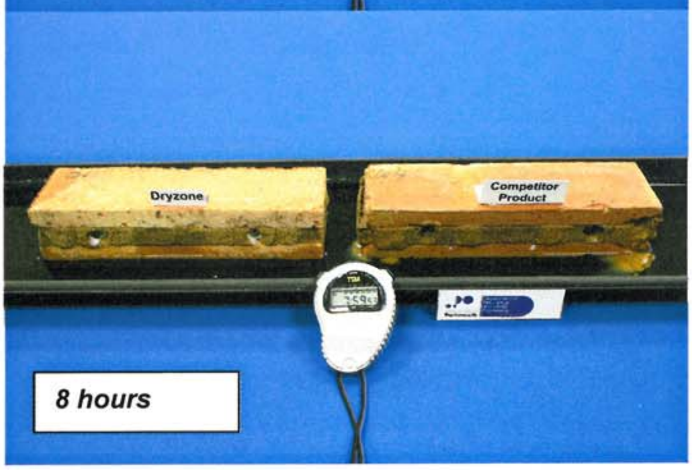

Dryzone
Competitor Product
30 minutes


Dryzone
Competitor Product
60 minutes


Dryzone
Competitor Product
75 minutes


Dryzone
Competitor Product
90 minutes


Dryzone
Competitor Product
2 hours


Dryzone
Competitor Product
8 hours

Time-lapse video

A time-lapse video was taken of the water rise. Single shots were taken every 10 seconds and then converted into a "mpg" file using Antechinus Animator and TMPGEnc 3.0 Xpress software.

This time-lapse video file entitled SAFEGUARD TIMELAPSE.mpg is available from the University of Portsmouth

Conclusions

The data shows the following points;

1. Water absorption occurs in both brick and mortar elements of the test materials.

2. The higher strength damp proofing creams are effective at reducing this absorption. Low strength creams appear to have minimal effect.

3. It is possible to model water absorption by classical diffusion equations. In the particular cases tested here, the two diffusion coefficients measured were 1.52 mm^2/s for high strength cream and 52.93 mm^2/sec on low strength cream.

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18/2/08

Appendices

Appendix 1: Sand grading

Seive grading	> 2.36 mm	1.18 - 2.36 mm	0.6 - 1.18 mm	0.3 - 0.6 mm	0.15 - 0.3 mm	< 0.15 mm	Total
Weight %	3	9	18	35	29	6	100

Appendix 2: Weight-time data from water absorption

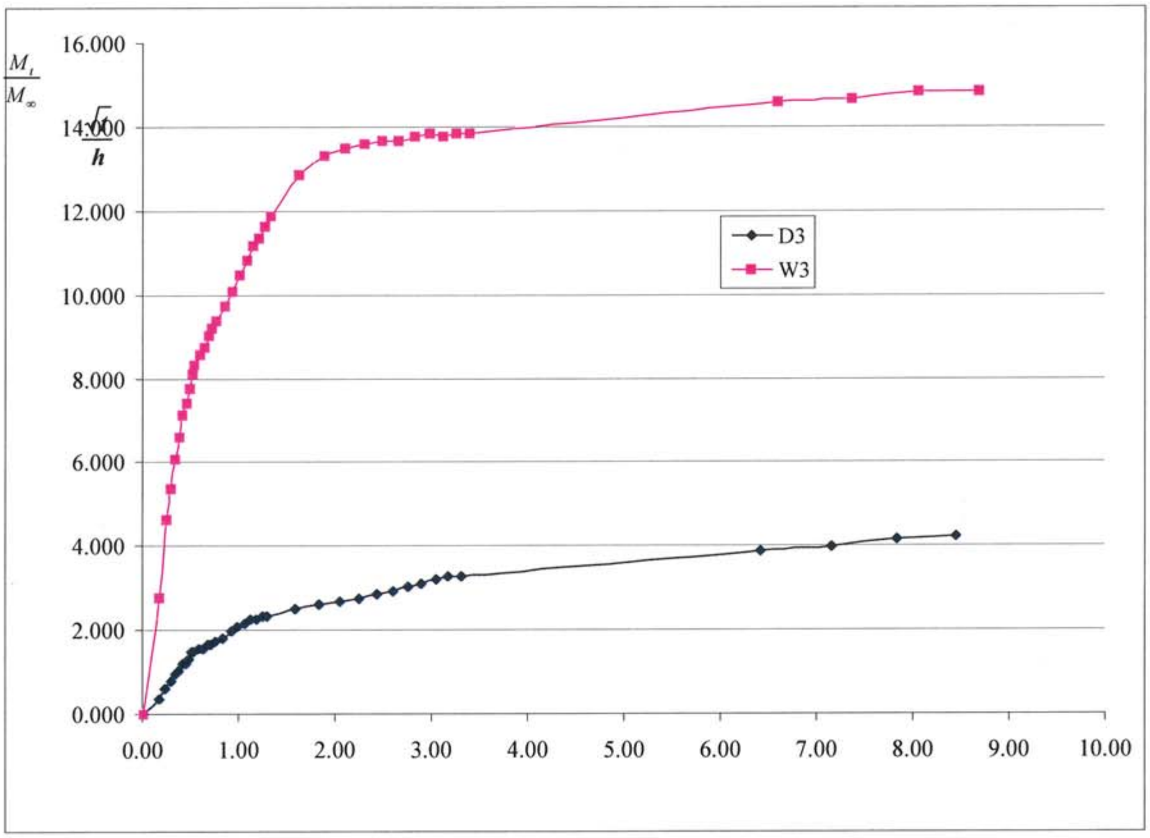
D3
Thickness (mm) = 46.29

	Time (minutes)	Weight Gain (g)	High strength cream	$\frac{\sqrt{t}}{h}$
	0	1160	0.000	0.0000
	1	1164	0.345	0.1673
	2	1167	0.603	0.2366
	3	1169	0.776	0.2898
	4	1171	0.948	0.3347
	5	1172	1.034	0.3742
	6	1174	1.207	0.4099
	7	1174	1.207	0.4427
	8	1175	1.293	0.4733
	9	1177	1.466	0.5020
	10	1177	1.466	0.5292
	12	1178	1.552	0.5797
	14	1178	1.552	0.6261
	16	1179	1.638	0.6693
	18	1179	1.638	0.7099
	20	1180	1.724	0.7483
	25	1181	1.810	0.8367
	30	1183	1.983	0.9165
	35	1184	2.069	0.9900
	40	1185	2.155	1.0583
	45	1186	2.241	1.1225
	50	1186	2.241	1.1832
	55	1187	2.328	1.2410
1 hr	60	1187	2.328	1.2962
	90	1189	2.500	1.5875
2 hrs	120	1190	2.586	1.8331
	150	1191	2.672	2.0494
3hrs	180	1192	2.759	2.2450
	210	1193	2.845	2.4249
4 hrs	240	1194	2.931	2.5924
	270	1195	3.017	2.7496
5 hrs	300	1196	3.103	2.8983
	330	1197	3.190	3.0398
6 hrs	360	1198	3.276	3.1750
	390	1198	3.276	3.3046
24.5 hrs	1470	1205	3.879	6.4157
30.5 hrs	1830	1206	3.966	7.1584
36.5 hrs	2190	1208	4.138	7.8309
42.5 hrs	2550	1209	4.224	8.4500

W3
Thickness (mm) = 44.99

	Time (minutes)	Weight Gain (g)	Low strength cream	$\frac{\sqrt{t}}{h}$
	0	1118	0.000	0.0000
	1	1149	2.773	0.1722
	2	1170	4.651	0.2435
	3	1178	5.367	0.2982
	4	1186	6.082	0.3443
	5	1192	6.619	0.3850
	6	1198	7.156	0.4217
	7	1201	7.424	0.4555
	8	1205	7.782	0.4870
	9	1209	8.140	0.5165
	10	1211	8.318	0.5445
	12	1214	8.587	0.5964
	14	1216	8.766	0.6442
	16	1219	9.034	0.6887
	18	1221	9.213	0.7305
	20	1223	9.392	0.7700
	25	1227	9.750	0.8609
	30	1231	10.107	0.9430
	35	1235	10.465	1.0186
	40	1239	10.823	1.0889
	45	1243	11.181	1.1550
	50	1245	11.360	1.2174
	55	1248	11.628	1.2769
1 hr	60	1251	11.896	1.3336
	90	1262	12.880	1.6334
2 hrs	120	1267	13.327	1.8860
	150	1269	13.506	2.1087
3hrs	180	1270	13.596	2.3099
	210	1271	13.685	2.4950
4 hrs	240	1271	13.685	2.6673
	270	1272	13.775	2.8291
5 hrs	300	1273	13.864	2.9821
	330	1272	13.775	3.1276
6 hrs	360	1273	13.864	3.2667
	390	1273	13.864	3.4001
24.5 hrs	1470	1281	14.580	6.6011
30.5 hrs	1830	1282	14.669	7.3652
36.5 hrs	2190	1284	14.848	8.0572
42.5 hrs	2550	1284	14.848	8.6942

Appendix 3: Data plotted as root time divided by the thickness



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