KEIM Mineral Paints – Technical Digest

Breathability & Moisture Vapour Permeability

1. What is Breathability?

When the term breathability is referred to with reference to building materials it is not concerned with air, but with water in both liquid and gas form. Breathability tends to be used to describe the passage of water vapour and there are a variety of related terms that are used to quantify breathability.

Water affects everything in building from the health or decay of building fabric, through to the thermal performance of the building and to the health of occupants. Particularly as we try to increase the air-tightness, thermal performance and indoor air quality of our buildings, breathability has become a critical issue, affecting all areas both of new build and of renovation (1).

2. Vapour Permeability/Resistivity

Vapour permeability is the ability of a material to allow water vapour to pass through it. Here the water is in gaseous form (vapour), which will pass through the material at a rate that is determined by the pore size and thickness of the material.

Vapour permeability is referred to using the symbol r. This is a material property and is not dependent upon size, thickness or shape of the material. The units of r are either GNs/kgm (Giga Newton seconds per kilogram metre) or MNs/gm (Mega Newton seconds per gram metre).

3. Vapour Resistance

Vapour resistance is a term used in the construction industry. This is equivalent to the vapour permeability (r) multiplied by the thickness (in metres) and has units of GNs/kg or MNs/g. A material can therefore have a high r value, but a low G value if it is only thin (such as paint).

4. Water Vapour Diffusion Current Density (V)

The water vapour diffusion current density indicates how many grams of water vapour can diffuse per square metre area in one day through a paint layer. This can be calculated from the Sd value

$V = 21/Sd$
Keim Mineral Paint (Soldalit), Sd value = 0.0106, $V = 1968 g/m^2$
Conventional Paint, Sd value = 0.5, $V = 42 g/m^2$

5. Water Vapour Resistance Factor (μ)

This is a measure of resistivity as a ratio of the resistivity of still air. μ is a relative quantity, and hence is expressed as just a number with no units. This is a property of the bulk material and is not dependent upon size, thickness or shape.
The lower the μ value, the more 'breathable' the material.

6. Equivalent Air Thickness (sd)

This is a useful measure of breathability as it measures a materials resistance to the transmission of water vapour through it.

This can only be quoted for a particular thickness of material and is measured in metres. The units of Sd are given in metres and it refers to the resistance shown by the equivalent thickness of air, so the lower the number the better the breathability. Paints with Sd values below 0.1m are considered to have high breathability.

The diffusion equivalent air layer thickness specifies how thick a layer of air with the same diffusion resistance would have to be.

7. Water Absorption Co-efficient, W, Kg/m2.h0.5 (Capillarity)

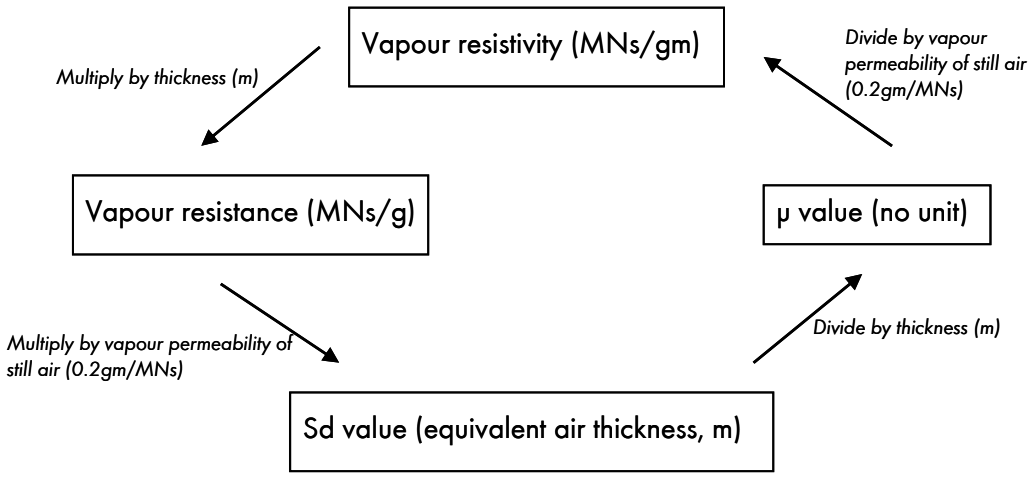
Capillarity refers to the absorption/ desorption of water as liquid.

Capillarity is a function of pore structure. It can be altered by coatings and additives and many of these act as hydrophobic agents by blocking these larger pores, but still allowing the smaller pores to remain open. In this way the pore structure may be kept open for hygroscopic and vapour permeable transfer of moisture but closed to capillary transfer of moisture. (1)

Capillarity is measured by placing a standard cube of material in water, with all sides sealed except the bottom. The weight of the material is then measured from time to time and this is expressed as a co-efficient w kg/m2.h0.5. (1)

W is used to measure the amount of liquid water absorbed by a material by direct contact.

8. Relationship Between Terms



9. What are the advantages of using a breathable paint?

Paints with high water vapour permeability ('breathability') enable humidity contained in building structures to be quickly released unhindered into the environment, avoiding moisture build up between coating and substrate. This helps to protect building structures from the damaging effects of build up of moisture.

Breathability also provides an aesthetic advantage as moisture is able to breathe through the coating, rather than being trapped behind an acrylic barrier. If moisture vapour becomes trapped, it will build up behind the coating eventually leading to blistering and flaking of the paint layers, as well as possibly saturated surfaces underneath which often become friable and need repairing.

10. Keim Mineral Paints

The micro-crystalline nature of mineral paints creates finite spaces between adjacent crystals; these voids are large enough to allow the free passage of vapour but small enough to prevent the ingress of driven rain. This imparts the Keim mineral paint system with high water vapour permeability.

There are, as mentioned above, ways in which breathability can be measured. One of the simplest ways in which Keim measure breathability is calculation of the Sd value, the lower the Sd value the higher the breathability.

Keim Mineral Paints have Sd values of around 0.01m (see Appendix 1)

Comparison of Keim Mineral Paints and conventional paints:
Keim Soldalit, Sd value = 0.011m (1.1cm)
Conventional emulsion paint: 0.5 = (50cm)

Testing of Sd values is carried out for Keim by the Fraunhofer Institute in Germany, and testing is done according to the standard DIN EN ISO 7783-2.

DIN EN ISO 7783-2: Paints and varnishes - Coating materials and coating systems for exterior masonry and concrete - Part 2: Determination and classification of water-vapour transmission rate (permeability) (ISO 7783-2:1999); German version EN ISO 7783-2:1999.

11. Keim Mineral Paints – Independent Comparison Study

Permeability tests were carried out by Orsi Contini Consultants (Appendix 2) comparing Keim Mineral Paints with conventional paints and limewash.

Three Fibrelime samples were each painted with
- 2 coats of white potassium silicate paint (Keim)
- 2 coats of conventional well known masonry paint
- 5 coats of limewash (70%water 30% putty)
- Three were left unpainted

The first test determined the time taken for the samples to reach full water saturation when immersed in water at 700C (equivalent to a weight of 62g).

The uncoated and limewashed painted samples absorbed water quickly and reached saturation within 9 and 10 seconds respectively. The painted samples took much longer to reach saturation point, Keim Mineral paint taking 125 minutes, and conventional paint taking 135 minutes, both protecting the surface from the ingress of water for a much longer period.

In the second test the samples were tested for the time take for the samples to reach their former dry weight of 50g in a thermostatically controlled oven set at 40C. This gives an indication of the vapour permeability of the coatings.

The unpainted and limewashed samples achieved their former weight within 5 hours, with the Keim Mineral paint taking 6 hours, indicating only a very small effect on the vapour permeability. The samples coated with conventional paint took 159 hours to retain their former weight, the coatings effectively retaining the moisture within the substrate.

Therefore the testing shows that mineral paints offer similar waterproofing properties to conventional paints, but with similar vapour permeability to uncoated / limewashed coatings.

12. Appendix 1 - Sd values for Keim Mineral Paints

Product	Resistance to vapour diffusion, sd, m
Keim Granital	0.01
Keim Royalan	0.01
Keim Soldalit	0.011
Keim Soldalit-ME	<0.01
Keim Ecosil-ME	<0.01
Keim Optil	<0.01
Keim Concretal W	0.02
Keim Concretal Lasur	0.01
Keim Concretal C	0.1

13. Appendix 2 - Permeability Tests, carried out by Orsi Contini Consultants

Test samples- 12 Fibrelime samples measuring 88x65X5 were made. Each sample weighed 50g.

3 samples were painted, 2 coats with white potassium silicate paint
3 samples were painted, 2 coats well known masonry paint
3 samples were limewashed (70% water 30% putty) with 5 coats,
3 samples were left unpainted

Absorption and moisture loss testing - The samples were submerged in water at 70° C until they reached full water saturation at a weight of 62g. The three sample types were then placed in a thermostatically controlled oven set at 40 degrees with an oven thermostat to double check the temperature. The samples were monitored for moisture loss every hour until they each reached their former dry weight of 50g. The test was repeated 3 times.

Results - Summary table from 3 repeat tests

	Potassium Silicate paint (Keim)	**Masonry paint**	**Limewash paint**	**Unpainted**
Hydration at 70°C to 62g	125 minutes	135 minutes	10 seconds	9 seconds
Dehydration at 40°C at 1hr intervals to 50g				
0hr	62g	62g	62g	62g
1hr	60g	61g	60g	58g
2hr	57g	61g	57g	56g
3hr	54g	60g	54g	54g
4hr	53g	60g	52g	52g
5hr	51g	60g	50g	50g
6hr	50g	60g		
7hr		60g		
8hr		60g		
9hr		59g		
24hr		59g		
48hr		57g		
72hr		56g		
96hr		55g		
120hr		54g		
144hr		52g		
159hr= 9,540 mins		50g		

References - (1) Breathability: The Key to Building Performance, Neil May 16/04/05.

For further information regarding the features and benefits of Keim Mineral Paints please contact our sales office – sales@keimpaints.co.uk or 01952 231250.