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Water vapour transmission properties of waterborne coatings — effect of selected parameters

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INTRODUCTION & AIM

Water-based coatings materials, due to their desirable properties such as very good resistance to weather conditions and flexibility as well as easy application, are used for both decorative and protective purposes. The ability of the coatings to transport water can affect fungi growth, loss of adhesion, or the penetration of aggressive ions from rain into the substrate. Therefore, determining the water transport properties of water by paints is a key point in determining their protective properties.

This study investigated the effects of preparation, conditioning, and testing methodologies on the water vapour permeability properties of waterborne coatings. The study was divided into two parts. In the first part, the influence of the binder content of the paint product, the film thickness, and the presence of different substrates on the water vapour permeability values obtained was determined. In the second part, the influence of conditioning and testing methods was investigated.

METHOD

Materials

Waterborne paint contain 7 wt.%, 10.5 wt.%, and 14 wt.% of acrylic-styrene binder.
Comercially avaliable waterborn paints.

Substrates:
- cellulose filter (FILTRAK/MUNKTELL filter paper 390),
- silicone treatment cellulose filter (Whatman 1PS Phase separating paper silicone treated),
- glass filter (PRAT DUMAS France).

Silica gel and saturated $NH_4H_2PO_4$ solution to fill measuring vessel.

Coatings preparation

Self-supporting coatingd

Applying on PE foil

Removing from PE foil

Preparation samples for tests

Non-self-supporting coatings

Applying on substrate (1 layer)

Drying and conditioning

(a) 14 days; T=(23±2)°C RH=(50±5)%

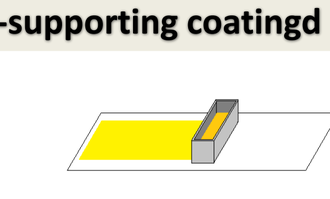
(b) 35 days (7 days drying nad 28 days of conditioning; T=(23±2)°C RH=(50±5)%

(c) 21 days (7 days drying nad 3 cycles of conditioning); one cycle contain: immerse in water st (23±2)°C for 24 h and drying in oven at (50±2)°C for 24 h
After cycles, coatings were condition at least 24 h at T=(23±2)°C RH=(50±5)%

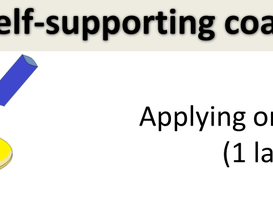
Sample obtained for tests

Water vapour transmission process

Wet cup method



Dry cup method



The mass of the vessel was determined on the analytical balance on the beginning of the process, and during experiment after adequate time period.

Based on the graph of the dependence of the mass loss/gain of the solution/silica gel on the test time, the value of water-vapour transmission rate was determined.

RESULTS & DISCUSSION

Influence of binder content and coating thickness

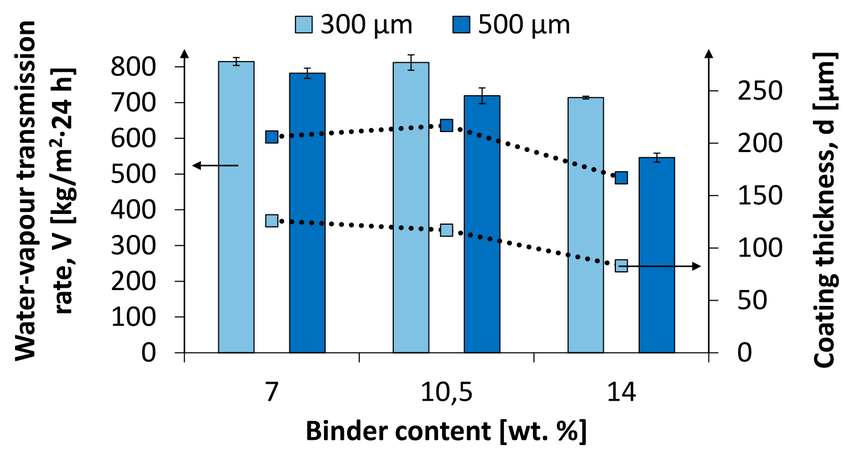


Fig. 1 Comparison of water-vapour transmission rates and thicknesses of coatings obtained with a 300 µm and 500 µm gap height applicators.

Influence of substrate

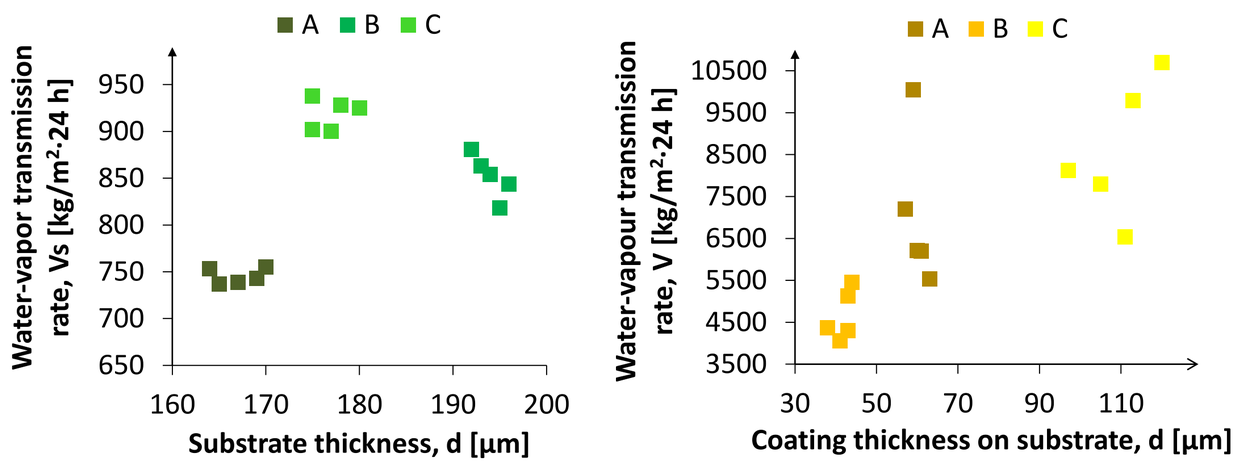


Fig. 2 Comparison of water-vapour transmission rate for coatings prepared from a substrate (left) as well as product containing 10 wt.% of binder on different substrate (right): (A) - cellulose, (B) - silicone-coated cellulose, (C) – glass.

Influence of conditioning and test methodology

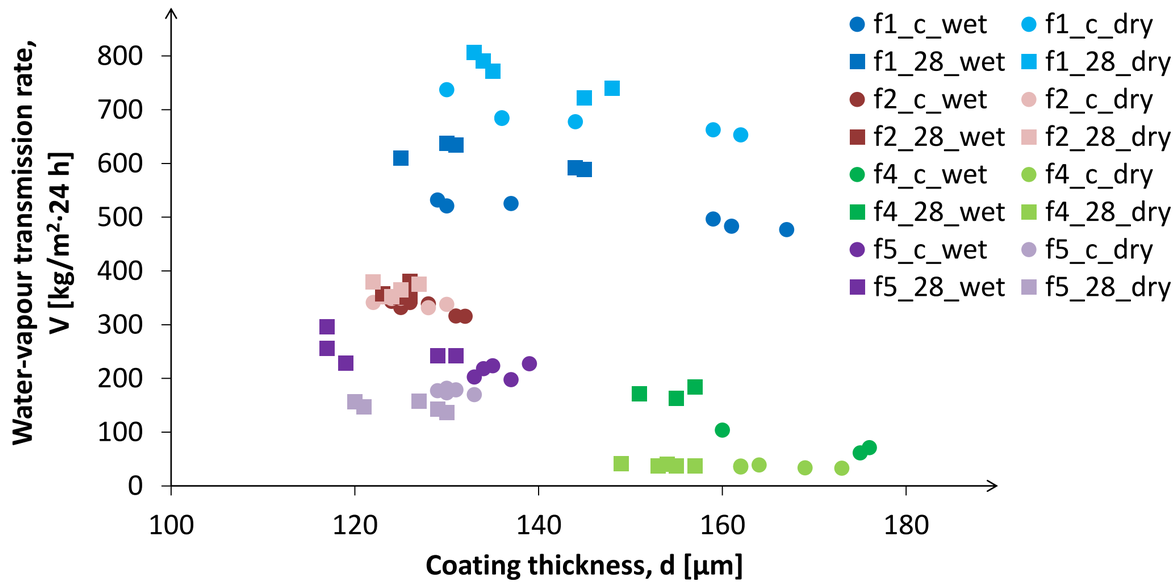


Fig. 3 Comparison of water-vapour transmission rate for coatings conditioned by 28 days (28) or by cycles (c) and tested by wet or dry cup method.

CONCLUSION

- On the basis of the results obtained, it was observed that the value of the water-vapour transmission rate decreased with increasing of binder content in the varnish product. Observed differences were the greater, the greater was the thickness of the coating tested.
- The water-vapour transmission rate across the substrate depends primarily on the affinity of the material for water molecules and decreases with increasing hydrophilicity of the material.
- The water-vapour transmission rate of a coating obtained on a support is strongly depend on its interaction with the substrate so their selection should be choosen carefully.
- The influence of the conditioning method and the test method on the V value is difficult to determine at this stage. Depending on the product being tested, different results can be obtained.