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Fluorinated Acrylics as an Alternative for Hydrophobic and Oleophobic Coating for Stone and Concrete

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Abstract

Fluorinated acrylics are widely used for the protection of leather, textiles and papers against stain and water. These polymers can be now found in suspension form or water solution with a little amount of hydrophilic solvent. It seemed to be interesting to test one of these products as an alternative for the coating of construction materials. Trials have been made with Foraperle 321 produced by ATOCHEM (France). Our work will describe the product and give some information about its effectiveness. Water absorption decrease without change in permeability to water vapour of the treated samples. In order to have a better understanding of the capability of this product, some experiments have been made with a silicone product widely used and called X.

Keywords: fluorinated acrylics, silicone, water absorption, water vapor permeability

1 Introduction

Since many years, the best way to protect the buildings frontages against water and its compounds seems to be hydrophobic treatments. Many systems exist which contain silicones, siliconates, silanes, metallic stearates and acrylic resins.

Some products have their better effectiveness only on some substrates. For example, aluminium stearates have a good performance on limestone when their concentration is greater or equal to 7% [1,2], but rarely on bricks. In fact the product used can not be dissociated from the substrate and its application concentrations are important. So, we choose three different substrates: sandstone, limestone and concrete.

Our presentation give fluorinated acrylics chemistry, stones used with the methodology of coating and our results in water protection and water vapour permeability.

2 Chemistry

Acrylic resins have a high molecular weigh. The monomer unit is :

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-[CH2---- CR1]-      with R1: -H or -CH3
           |         R2 is generally: -H, -CH3...
          C=O        -CnHn+1.....
           |
          OR2
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Radical R2 is fluorinated, this radical can have the following form –CH2-CF3 for example.

An important difference between fluorinated acrylics and silicones is surface energy of these molecules. Silicones appear to have a higher superficial energy. This difference explains some of the good behaviour of those products for oleophobic treatments.

3 Stone and concrete samples

Samples are cubic with 7 cm side or cylindrical with 4 cm diameter and 2 cm high.

Trials are made with sandstone and limestone in the directional and upright lithology, and with the concrete which is accepted to be isotropic. Red sandstone comes from Rothbach (Alsace, France), limestone from Saint Maximin (France). Aggregates of concrete have a diameter less than 25 mm. Characteristic data of the samples are given in table 1

Table 1: Characteristics chart of the samples

	Limestone	Sandstone	Concrete
Capillarity lithology	67	12	6
Capillarity lithology upright	59	4	6
Porosity %	37	19	12
Apparent volumetric mass T/m3	1.7	2.1	2.25
Bulk mass T/m3	2.7	2.6	2.6

4 Treatments and trials with the Karsten pipe

Dilution of the product is fixed to one part of pure product for nine parts of water. The aim is to find the minimal product quantity necessary to have the minimal water absorption (trial face is upright to the lithology for stones). The application was made with a brush touch by touch for a definite volume and surface. The cubic samples were first dried during 48 hours at 20°C and 50% relative humidity before treatment.

The Karsten pipe results after 15 min for Foraperle 321 and silicone X in function of the amount of treatment for 1 m^2 are given in figure 1 and 2:

Foraperle 321 is more efficient for limestone (no absorption for more than 300 ml/m^2 treatment) and silicone is more efficient for sandstone. The results in the lithological direction are similar. For the concrete, both products are efficient but the absorption without treatment is poor.

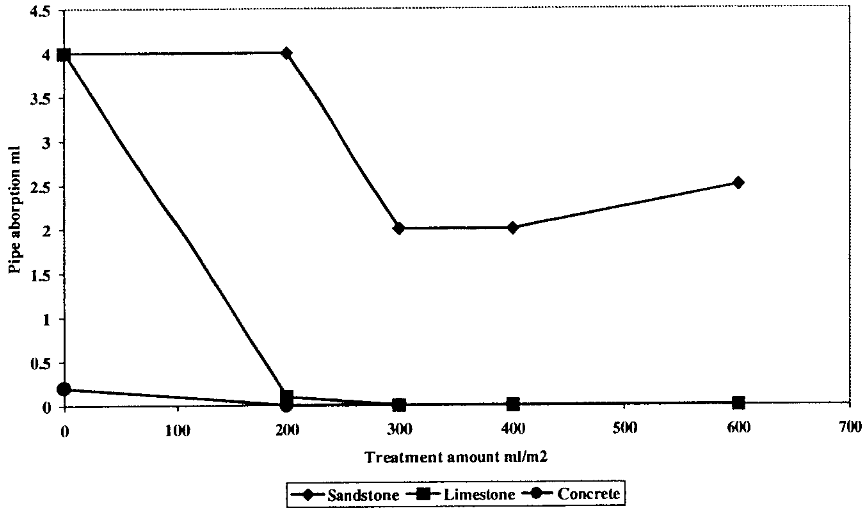

Figure 1: Karsten pipe absorption after Foraperle 321 treatment

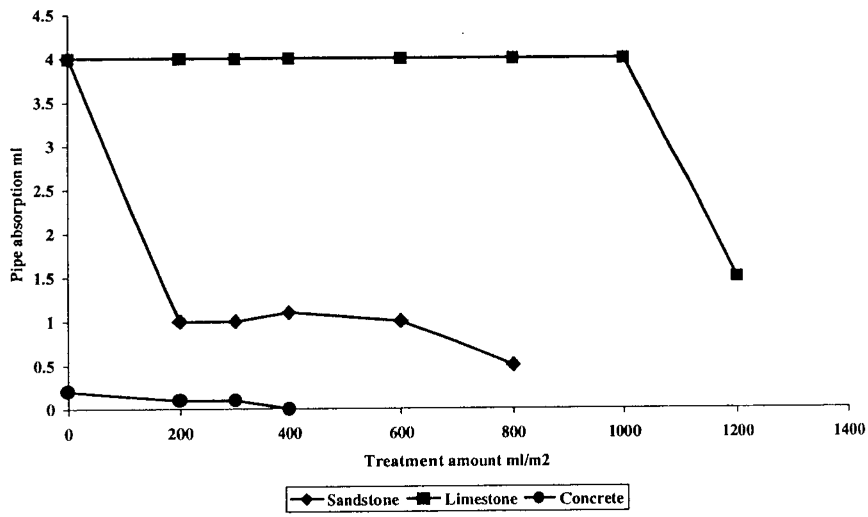

Figure 2: Karsten pipe absorption after treatment with Silicone X

5 Water vapour permeability

The superior surface of a cylindrical sample upright to lithology is treated with a solution of 800 ml/m^2 of diluted Foraperle. The sample is put in a oven at 80 % relative humidity and 20 °C. It is sealed in a container (figure 3) which have silica gel (relative humidity inside container is 5 %). The whole is weighed once or twice each day.

In these conditions, we can give the amount of water vapour in grams, which goes through one square meter sample in one hour at equilibrium (table 1). The permeability of the treated sample decreases but the change is poor.

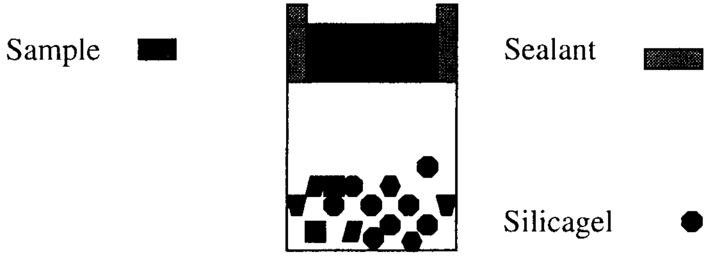

Figure 3: Device for water vapor permeability measurement

Table 2: Water vapour permeability at 20°C

	Water vapour permeability (g/m2 h)		
	Limestone	**Sandstone**	**Concrete**
Untreated sample	0.552	0.211	0.153
Treated sample	0.472	0.175	0.138

6 Conclusion

The product Foraperle 321 seems to have an efficiency for stones and concrete hydrophobic treatment. Further, we try to measure his weatherability and how the product is fixed on different substrates with different porosities in order to understand why the Foraperle has a good behaviour for limestone.

References

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