Araldite AZ 15 Impregnation of Kaolin

by

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Introduction

IMPREGNATION is a technique by which a clay can be solidified by replacing the pore fluid by a solidifying material. There are many resins which can be used as a *solidifying material, such as Araldite AY18*, Bakelite, Vestopal W, Epikote, *etc*. The resin which will be described here for impregnation purposes is Araldite AZ15. This is a resin not previously reported as having been used for clay impregnation. It was selected for the following reasons :

(*a*) The resin-hardener mixture has a low viscosity which, when diluted with acetone or styrene penetrates fully into the specimens.

(*b*) It has higher shearing and bending strength than Araldite AY18 (1967 and 1970).

(*c*) It has a very long pot-life.

Impregnation Technique

'Supreme' Kaolin supplied by English Clay Lovering Pochin was used for this investigation. The properties of the Kaolin are listed in Table I. It was fractionated by gravity sedimentation to produce a material having a restricted particle size range (Figure 1) and consolidated at different pressure ranging between 4.75 kg/cm^2 to 45 kg/cm^2. The consolidated Kaolin was cut with a sharp razor blade to obtain 25 mm $\times$ 12 mm $\times$ 2$-$3 mm slices which were immediately placed in a glass petri dish full of distilled water.

At the next stage, the Kaolin slices, submerged in distilled water, were placed in a 25 percent methanol—75 percent water bath for one day and the concentration of the methanol was increased subsequently by 25 percent each day until the Kaolin slices were in 100 percent methanol; the methanol was replaced similarly by increasing the concentration of acetone by 25 percent each day until the Kaolin slices were saturated in 100 percent acetone. The whole process was carried out at room temperature.

The resin-hardener was mixed up as follows :

100 gm of Araldite AZ15

30 gm of Hardener HZ15

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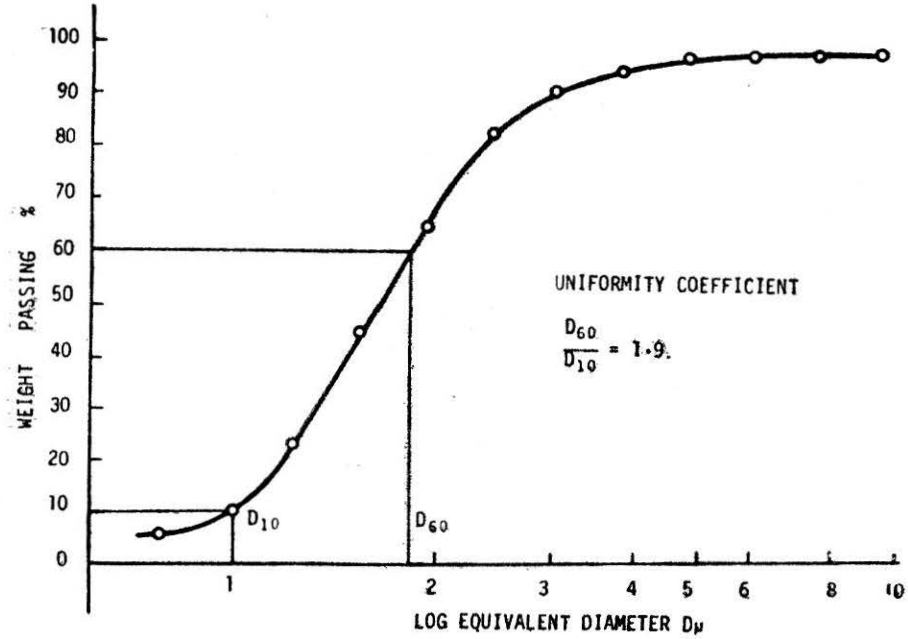

FIGURE 1: Particle size distribution of fractionated Kaolin.

TABLE I

"Supreme" Kaolin properties.

Chemical analysis element	Percent
SiO_2	46·6
Al_2O_3	38·3
Fe_2O_3	0·49
TiO_2	0·05
CuO	0·2
MgO	0·2
K_2O	0·68
Na_2O	0·07
Classification after fractionation	
Liquid limit	69·3
Plastic limit	53·6
Plasticity index	15·7
Activity	0·23
Uniformity coefficient	1·9
Particle form factors	
Length/width	1·1
Length/thickness	12

"Supreme" Kaolin is supplied as a paper clay by English Clays Lovering Pochin, St. Austell.

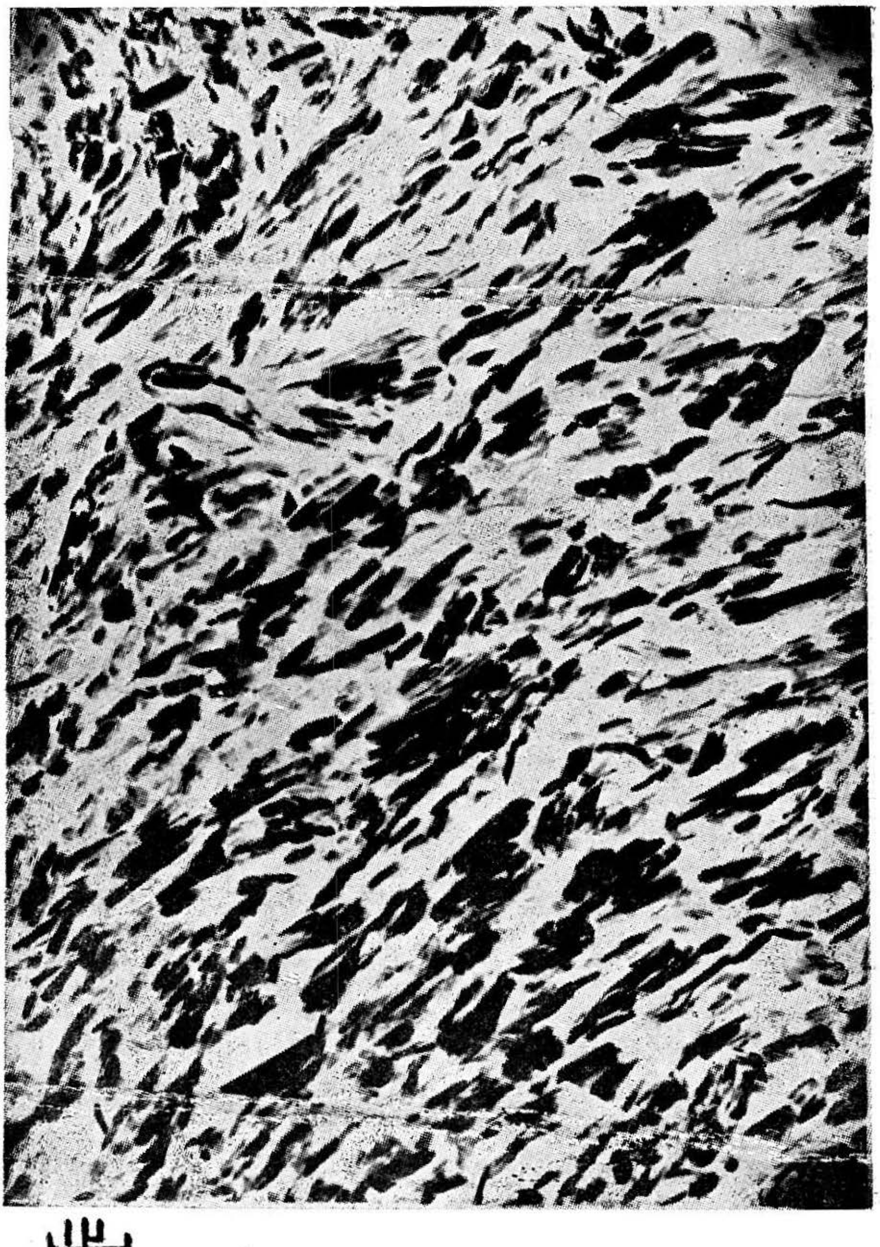

FIGURE 2 : **Araldite AZ 15 impregnation of Kaolin. Max Consolidation load 45 kg/cm^2. Thickness of the ultra-thin section 900 A°. Diamond Knife.**

The mixture was thoroughly mixed and 10 gm of acetone or 5 gm of styrene was added to reduce the viscosity of the resin-hardener mixture. The Kaolin slices were taken out of 100 percent acetone, the acetone being drained off and the resin-hardener mixture with the diluting agent was poured in until it topped the Kaolin slices. The whole petri dish with the Kaolin slices with the resin-hardener system was covered and kept at the room temperature for four days for effective impregnation.

As the resin-hardener system did not solidify at room temperature, the curing of the impregnated clay slices was done with gradual increase

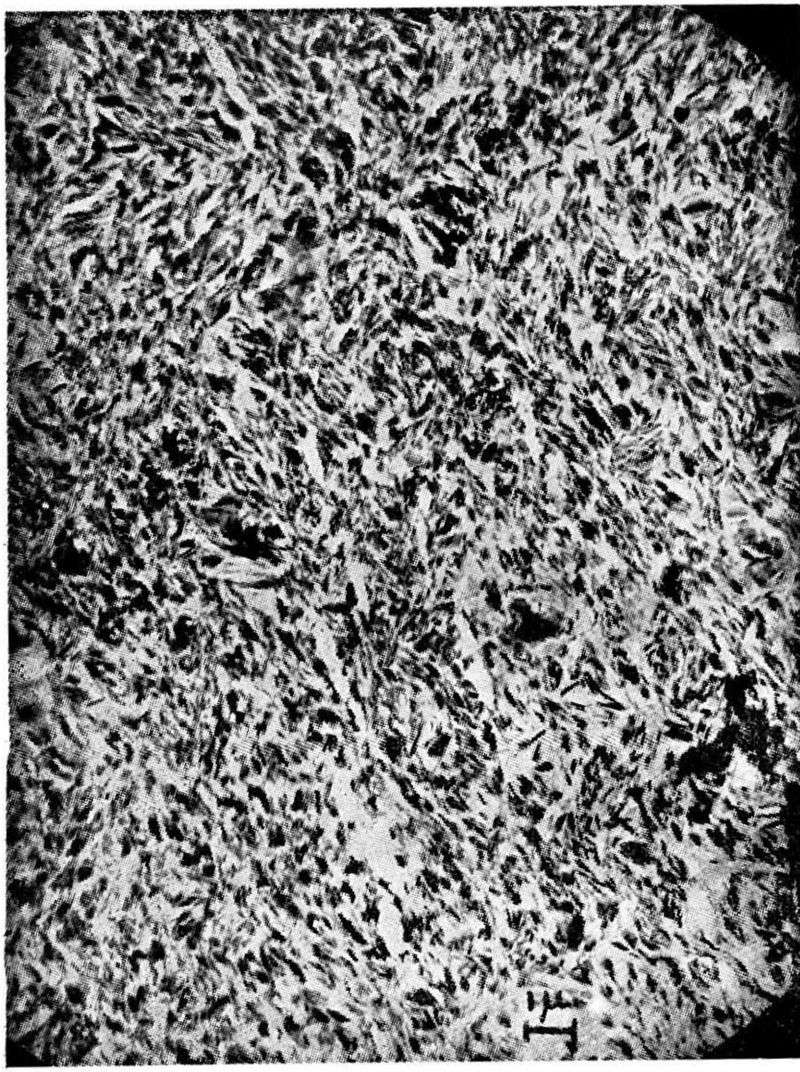

FIGURE 3: Araldite AY 18 impregnation of Kaolin. Max consolidation load 22kg/cm.^{2} Thickness of the ultra-thin section 900 A°. Diamond Knife.

in temperature from 35°C to 105°C with two intermediate stages at 45°C and 65°C.

Results

The solidified resin-hardener mixture was of light golden colour with occasional hair cracks due to the internal shrinkage which occurred at the curing stage, as these were not present when it solidified at 35°C. These cracks were usually not through the samples but through the surrounding resins. At 105°C often the resin-hardener mixture started bubbling, damaging the fully impregnated Kaolin slices.

It was not very clear why the bubbling started in some cases, but it was most likely that the presence of entraped diluting agent was responsible for it.

The ultimate curing temperature of 105°C for Araldite AZ15 should not be taken as a great disadvantage. Although the amount of disruption of soil microstructure due to high temperature curing is difficult to estimate accurately, experience with chalk impregnation at different curing temperatures suggests that the effect can be insignificant. It should be borne in mind that, in the majority of cases further expansion and/or contraction of the samples virtually ceased after the initiation of polymerization.

The impregnated slices were hard. It was even harder than the samples impregnated with Araldite AY18 (1970). Figure 3 shows an electron micrograph of the Kaolin, impregnated with Araldite AY18. The sample was taken 5 mm away from the main shear discontinuity of a shear box specimen and was thus somewhat disturbed. However, it serves our purpose for illustration and comparison between the two impregnating media. Small tears and holes could be seen in Figure 3, whereas Figure 2 shows a very satisfactory micrograph of the Kaolin, impregnated with Araldite AZ15.

Although studies were done at different pressures, ranging between 4.75 kg/cm^2 to 45 kg/cm^2, illustration showing the change in particle orientation with increasing consolidation load is out of the scope of this paper; however, an interesting comparison can be made out of Figure 2, Figure 3 and the recent publication of the author (1971).

The ultratome used for producing ultra-thin sections was an LKB Ultratome III. The electron microscopy was performed with an Elmis-Kop II. The ultra-thin sections of Araldite AZ15 impregnated samples were stable under the electron bombardments.

Conclusions

Although the paper deals with the investigation on two samples only, in fact a large number of samples were tested to establish the technique; the variety of the samples include Kaolin, natural chalk, Norwegian clay and London clay. In almost all cases, the impregnation technique was found to be satisfactory and although some troubles were experienced in resin impregnation with Araldite AZ15, nevertheless it was promising. Further research is needed to establish it as a standard resin for clay impregnation.

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