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Report No. R17441

FIRE TESTING OF ICI ACRYLIC, IN ACCORDANCE WITH THE LONDON UNDERGROUND LIMITED ENGINEERING STANDARD E1042: A2: OCTOBER 1996.

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1. INTRODUCTION

Sample specimen panels of ICI Acrylic were submitted on 23 March 1999, by Mr M Lombard of ICI Acrylics, for fire testing in accordance with London Underground Limited Engineering Standard E1042: A2: October 1996.

2. MATERIAL DESCRIPTION

1000 X 500 X 10mm, clear plastic panel, referenced ICI Acrylic, manufactured by ICI Acrylics.

Laboratory sample reference is A/30146/1.

3. TEST METHOD

3.1 SMOKE EMISSION

The smoke emission test on the specimen sample was tested on 28 April 1999, in accordance with BS6853: 1999: D.8.3 - "Code of practice for fire precautions in the design and construction of passenger carrying trains".

3.2 TOXIC FUME EMISSION

3.2.1 QUALITATIVE ANALYSIS

The specimen sample was tested on 31 March 1999, for Qualitative elemental determination by scanning electron microscopy and energy dispersive X-Rays.

3.2.2 QUANTITATIVE ANALYSIS

The specimen sample was tested on 31 March 1999, for Quantitative determination for Nitrogen, Carbon and Sulphur using Carlo Erba EA1108 Elemental analyser'.

4. RESULTS

The tests relate to the behaviour of test specimens of the products under particular conditions of test; they are not intended to be the sole criterion for assessing the potential fire hazard of the product in use. In particular, differences in the thickness, orientation or design may significantly affect fire performance and care should be taken to ensure that any differences between the test conditions and application conditions are not adversely significant.

4.1 SMOKE EMISSION

%Transmission ($100\ I_t / I_o$) against time was recorded (Figure 1; Page 9)

The measured absorbance A_m is calculated in accordance with the Beer-Lambert Law as follows:

$$A_m = \log_{10} (I_o / I_t)$$

Where: I_o = Initial Luminous intensity
I_t = transmitted Luminous intensity

A_m is converted to Standard absorbance A_o (Figure 2; Page 9, using the equation:

$$A_o = (A_m \times V) / (n \times L)$$

Where: V = volume of the cube ($27m^3$)
L = optical path length (3m)
N = is the number of units comprising the specimen (mass of test specimen; 117.0g)

The calculated results and the requirements are as follows:

Sample reference	Results A_o(abs)m^2/g	Requirements A_o(abs)m^2/g
A/30143/1	0.0110	<0.005 for 'Extensive & grouped' usage <0.02 for 'Limited and dispersed' usage

4.2 TOXIC FUME EMISSION

4.2.1 QUALITATIVE ANALYSIS

The elements detected are given below as seen by Figure 3; Page 10.

Sample reference	Elements detected
A/30143/1	Carbon, oxygen, aluminium.

4.2.2 QUANTITATIVE ANALYSIS

Sample reference	% Nitrogen	% Chlorine	% Sulphur
A/30146/1	0.10	60.56	<0.01

The above results are expressed as a percentage wt/wt.

REQUIREMENTS

The Engineering Standard states that "For unrestricted use of a material, covered by Standard E1042: A2: October 1996, neither it nor its constituents shall have deliberately incorporated by selection, addition or modification any significant amounts of organically bound halogens, nitrogen, sulphur or phosphorus; typical chemical groups proscribed are:-

C-X (where X = Halogen)
C-N
C-P
C-O-P
C-S
C-O-S

Trace levels of such chemical groups are acceptable – the criterion for "trace level" shall be that the summation of the weight for weight percentage of the chemical group divided by the atomic weight for the group shall not exceed 0.015".

The product shows 0.10% nitrogen content. Thus, applying the 'Trace level' criteria i.e.

$$\sum \frac{w/w\%\ of\ Chemical\ Group}{Atomic\ weight\ of\ Group} \leq 0.015$$

The calculated value for the ICI Acrylic is 0.0071. Hence, ICI Acrylic complies with the toxic fume emission requirements of the above engineering standard.

5. CONCLUSION

The product described in section 2 of this report meet the smoke emission and flammability requirements of the London Underground Limited Engineering Standard E1042: A2: October 1996, for Category 'limited & dispersed' (-/EQ/l limited & dispersed).

OBSERVATIONS

SAMPLE REFERENCE A/30143/1

TEST 1.

[illegible]	[illegible]
0.00 – 3.00	Nothing significant.
3.00 - 12.00	Material flames
12.00	Material consumed
13.00 -40.00	Nothing significant

Figure 1: Plot of %Transmission Versus Time for "ICI Acrylic".

Laboratory sample reference: A/30143/1

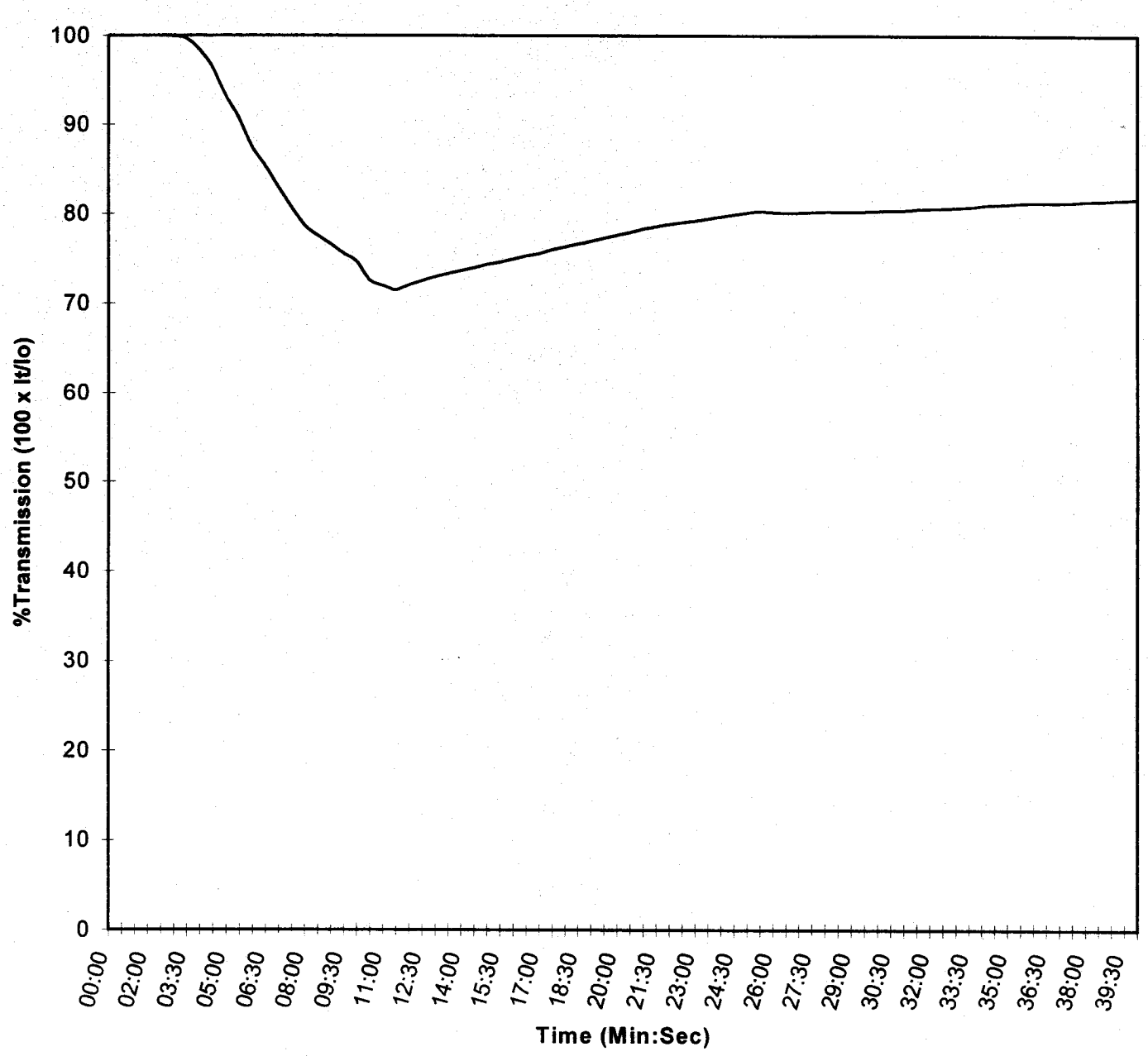

Figure 2: Plot of Absorbance Versus Time for "ICI Acrylic".

Laboratory sample reference: A/30143/1

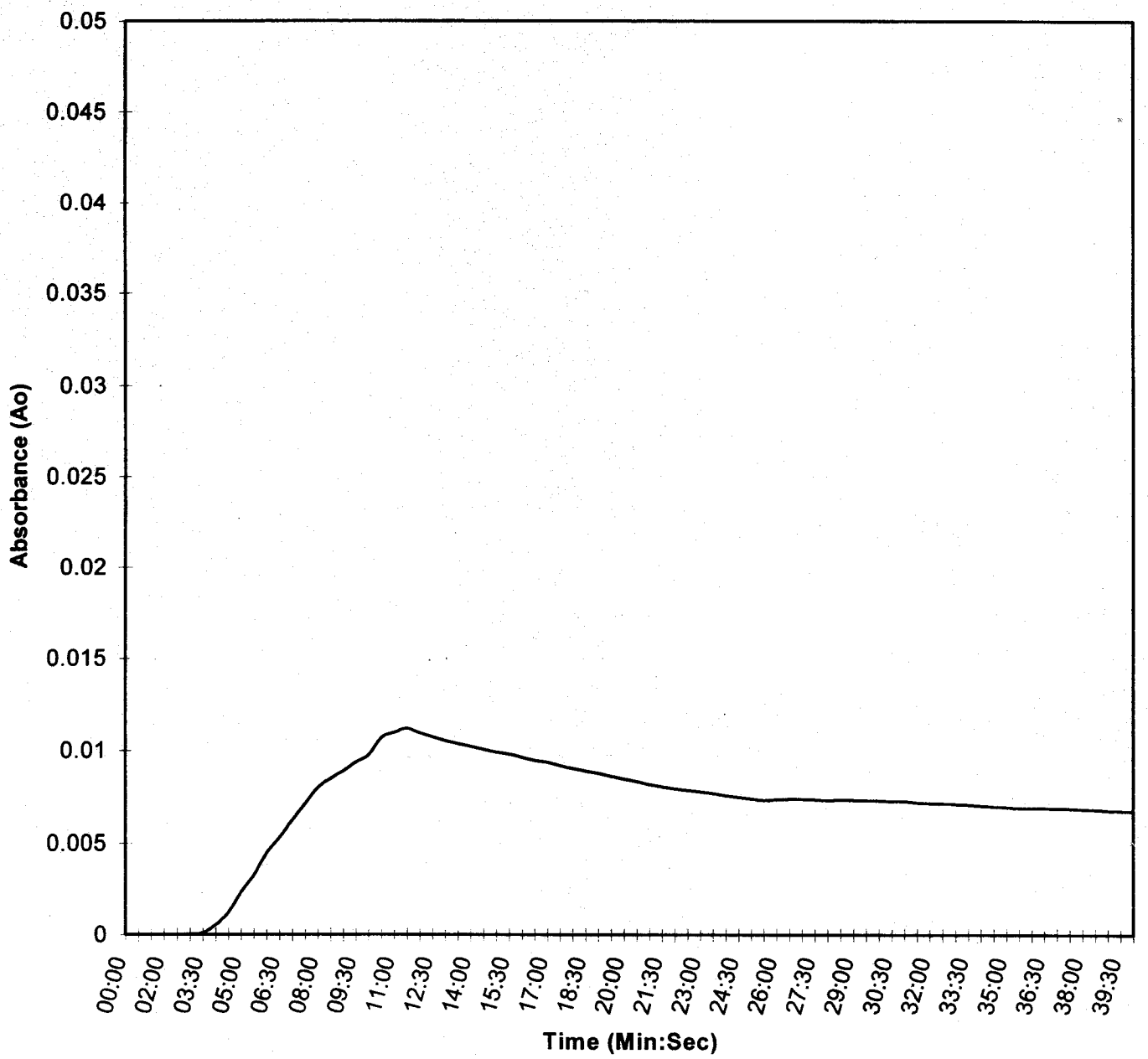

Figure 3: X-ray spectrum for for "ICI Acrylic".

Laboratory sample reference: A/30143/1