DETERMINATION OF DEFECTS DEPTH AND POROSITY IN THE STRUCTURE OF COMPOSITE INTEGRAL FOAMED PLASTICS

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Defects in the structure and the possibility of porosity determination in specimens and parts of structural foamed composite thermoplastics (on the basis of a newly developed method and device with the use of X - ray display equipment) have been investigated. Possibilities for nondestructive control and evaluation of porosity in local section of the parts, optimum structure formation and some process parameters are shown.

INTRODUCTION

The foamed plastics parts (including partially foamed thermoplastics) have a widespread application in the production of heat-insulating construction materials designated for the aviation, ship-building,tool and machine, chemistry, sports and other industries. Solving different problems are determined to a considerable degree by the porosity (density) and the possibilities for its effective control. X - ray defectoscopy method, developed and represented in the recent work for research and quality control of investigated objects porosity, which gives the possibility for quantitaive evaluation of porosity in determined local section or along the cross-secton of the casting. Using a video X - ray unit permits direct observation of thermoplastics lattice, the dense coating, and the unfoamed zones of the parts [1].

EXPERIMENTAL, ANALYSIS, DISCUSSION

The foamed structure is X - ray treated. The transmitted X - rays are

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indicated on a photographic plate. The received dark images on the photographic plate are measured by microphotometer. By use of calibration curves (**Fig.1-a**), which show the dependence of the shadowness **S** on the thickness of the specimen plates **d**(mm), the effective depth of the pores in the investigated objects could be evaluated. For the **X** - ray treating an **X-** ray unit „**Super 200**" was used. The operating regime was: Voltage (**U**) - 50 kV, Amperage (**I**) - 3 and 2.5 mA. Exposition time - 90 S. Focus distance - 800,700 mm. Together with each part specimens with different thickness (3,6,9,12,15,18 mm) were photographed. **Table 1** shows the results of the measured porosity of two type composites: polyethylen „**Bulen**" with gasificator „**Porofor D-30**" in quantity 0.5 mass % (No 1-3) and 0.8 mass % (No 4-6). The two average operating regimes are illustrated on **Fig 1-a** (2,3). The estimated square root declination is 1.107 mm. Variation coefficient is 0.122. The developed technology shows the possibility for determination of defects and micropores in the castings dense section. The depth of defects is measured by photo-electricity due to the brightness of the defects copy on the television screen. On the units screen the defects could be observed as bright spots with different sharpness in dependence of their size. When an indicator on the TV screen unit is placed, through the photocell passes current, which is recordered by the galvanometer. This electric current depends of the defects brightness, respectively from the **X** - rays current towards the screen, which is much more stronger when the size of the defect is larger along the beams direction.

TABLE 1 Experimental results for porosity in foamed plastics specimen

CASTING No	d - DENSITY MASS 2	3	d - AVERAGE (mm) 2	3	POROSITY (%) 2	3
1	9.2	9.2	0.8	0 8	8.0	8.0
2	9.4	9.3	0.6	0 7	8.0	7.0
3	9.3	9.2	0.7	0 8	7.0	8.0
4	8.7	8.7	1.3	1 3	13.0	13.0
5	8.8	8.9	1.2	1 1	12.0	11.0
6	8.8	9.0	1.2	1 0	12.0	10.0

The measurement is carried out as follows: terraced (stepped) specimen (from the same material as the investigated part) is **X** - rayed. Curve is designed by measured photoelectricity as function of **X** - rayed thickness. Then the investigated part is **X** - rayed under operating conditions equal to the specimens. The units indicator was placed over the exposure of the

defects on the screen and from the drawn calibrated curve the effective thickness d_{eff} is determind (includes the thickness under the defect), after which the indicator is placed very near to the defect. From the measured value of the photoelectricity, d_0 in the measured point is determined. From the substraction $\Delta d = d_0 - d_{eff}$ (along the **X**-ray direction) the size of the defect is determined. With a special blinding of the units indicator hole a cross section of the defect could be presented. This gives an information of its size along the **X** - rays direction. An **X** - ray set type K 7-3 „**Medicore**" for visual observation was used. Operating conditions: **U** = 42 kV, **I** = 0.7 mA. A terraced specimen from the investigated thermoplastic was used for establishing the calibration curve - specimen thickness is 2,3,4 and 5 mm. The working device is shown on **Fig.2**, and on **Fig.1b** in co-ordinate „photoelectricity - X - rayed thickness" the calibrated curve is shown. From this curve the size of the defects are determined using the method (**Table 2**). In the last column on the **Table 2**, the depths of the defects (measured by instrumental devices) are given. From the comparison of the results it could be seen that the relative error does not exceed 2 %.

TABLE 2 Experimental results from the measurments of the defects in specimens of partially foamed thermoplastics

CAS-TING No	I (divi-sions/ A)	d_{eff} mm	I (divi-sions/ A)	d_0 DEFECTS SIZED BY THE METHOD mm	mm	DEF.DEPTH INSTRUM. MEASURED mm	RELATIVE ERROR %
1	795	2.48	725	2.85	0.38	0.40	0.7
2	600	4.30	585	4.70	0.35	0.30	1.1
3	632	3.65	625	3.75	0.16	0.20	1.1
4	855	2.25	770	2.55	0.40	0.45	2.0
5	665	3.25	640	3.45	0.15	0.25	1.4

CONCLUSIONS

1. A newly developed X - ray method for determination the foamed plastics porosity has been proposed, different from the ones used till now.

2. Possibilities for nondestructive control of constructional foamed plastic parts structure formation and the porosity dependence of the parts service capabilities were shown.

3. Using this method is possible to forecast and optimise some of the thermoplastic melts processing parameters.

4. The proposed method permits quantitative evaluation of investigated defects parameters in the thermoplastics matrix defects size, depth, loosened zones of the tips of microcracks lattice.

REFERENCES

(1) Rumjantzev, S.W. Radiationnaja defectoscopia, "Atomizdat", Moskwa, 1970, p. 289.

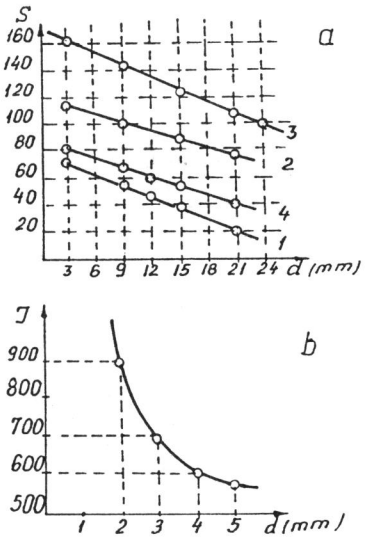

Fig.1. Calibration curve in the system "a" and "b".

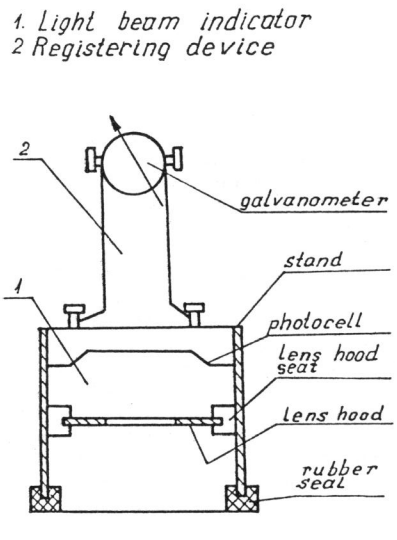

Fig.2. Principal Scheme of defect measuring device.