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Short Communication

Some observations on cold casting of Araldite sheets for photoelastic analysis

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Abstract

The influence of blemishes on the isochromatic fringe pattern in a stressed photoelastic model made from a 'defective' photoelastic material was examined. While the presence of air bubbles does not distort the pattern, 'mottling' does.

Key words: Photoelasticity, cold casting, effect of mottling and air bubbles.

1. Introduction

Photoelasticity occupies an important place among the several experimental stress analysis techniques. An ideal photoelastic material has to satisfy the property of homogeneity, among other important properties like high sensitivity, etc.[1] The blemishes that could occur in a photoelastic material while casting are: (a) mottling, the cause of which is not clearly understood, and (b) the presence of entrapped air bubbles. The photoelastician often treats with suspicion the material with the above blemishes and summarily discards it.

The investigation reported in this paper was carried out to find out the effect of mottling and the presence of air bubbles on the fidelity of the fringes. Experiments were carried out using a material (a) presumably free from the above blemishes, (b) which had mottling, and (c) which contained myriads of tiny air bubbles. The specimens investigated were: (i) a circular disc subjected to diametral compression, and (ii) a single edge notch specimen subjected to tensile load.

2. Materials and methods

Resin CY 230 (BIS-A epoxy) and hardener HY 951 (triethylene tetramine) manufactured by M/s Hindustan Ciba-Geigy (both liquids at room temperature) were used for cold casting of Araldite sheets.

Two-dimensional specimens were made from epoxy sheets cast using resin and hardener in the ratio 100:9 by weight. The sheets were cold cast using a mould made of metal or thick perspex sheets (20 mm thick). The mix of the resin and hardener was homogenised and cast into the mould avoiding the entrapping of air bubbles. Polymerisation takes around 70 hours depending on the resin and hardener proportion. After the sheet has polymerised it was removed from the mould and examined for the soundness of the casting and fitness of the material for making specimens.

Residual stresses, if any, were removed by a few cycles of annealing to relieve the stresses. However, other blemishes such as mottling and entrapped air bubbles render the material unfit for making specimens for photoelastic analysis.

It must be pointed out that the trapping of myriads of air bubbles was not deliberate but was fortuitous. The average size of the air bubble was 0·009 to 0·012″ (250 microns) as observed under a profile projector with a ×10 magnification.

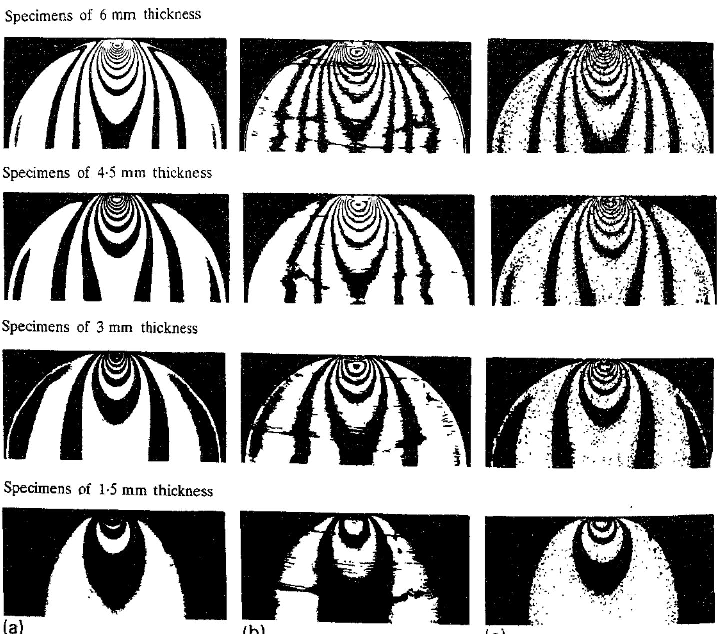

FIG. 1. Fringe patterns in circular discs subjected to diametral compression. (a) without blemish, (b) mottled specimen and (c) with entrapped air bubbles.

The present investigation was undertaken to examine the following:

Fidelity of the fringe pattern in a specimen made from a cold cast sheet with (a) mottling, and (b) entrapped air bubbles.

The following specimens were examined:
(a) circular discs subjected to diametral compression.
(b) notched specimens as normally used in the determination of Mode I stress intensity factor in fracture mechanics studies.

In all the specimens investigated the fringe patterns were 'frozen-in' by the usual method.

Figure 1 shows the fringe patterns obtained for the circular disc specimens made from a cold cast sheet (i) without any blemish, (ii) with mottling, and (iii) with entrapped air bubbles.

The three specimens were of the same nominal diameter and thickness of 60 mm and 6 mm respectively. The same load was imposed on all the discs for diametral compression. They were of necessity taken from different stocks and hence had varying material fringe constants. Hence the disc with mottled structure showed higher fringe orders. This could also have been further accentuated owing to the physical dimensions not being identical. Too strict a care was not exercised in this regard as the investigations were centered around the fidelity of the fringes which is qualitative in nature.

The study was extended to thinner specimens. Stress-frozen specimens were thinned out in steps of 1·5 mm, starting from a 6 mm specimen up to 1·5 mm, by rubbing the specimens on graded emery sheets avoiding temperature rise (fig. 1).

3. Conclusions

From an observation of the fringe patterns the following conclusions appear quite reasonable: (1) mottling decidedly distorts the fringe pattern, and (2) the entrapped air bubbles do not distort the fringe pattern.

The possibility of air bubbles causing perforations is very remote considering the size of the air bubble *vis-a-vis* the specimen thickness for a two-dimensional analysis which is quite often not less than 3 mm.

Similar results were obtained with SEN (single edge notch) specimens.

Reference

1. Dally, J.W. and Riley, W.F. — *Experimental stress analysis*, McGraw-Hill Book Company, Second Edition, 1978, pp. 473–486.