Defoaming of Newsprint For Use in Cementitious Composite material

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ABSTRACT: *– In order for using old newsprint for cement composite, the foam generation problem was studied. 3 locally available daily newspapers have been taken and analysed to find out the cause of foam generation. 5 defoamers available commercially have been added to the pulp from newsprint. The defoamer, its concentration and pulp consistency have been optimised by measuring the volume of foam generated during beating.*

INTRODUCTION

The cellulosic fibres, meant for paper manufacturing, have adequate physical and mechanical properties for use in composite materials with various polymer, cement and asbestos (1, 2). These fibres can not only increase the overall composite property but reduce the cost also. In this work, the old newsprint was conceived for such use. It was observed that lot of foam is generated while mixing with cement or asbestos. It was therefore necessary to find out suitable defoamers and conditions to suppress the foam produced. This work is devoted to the defoaming of newsprint.

Foam can be formed from a large number of resins and sodium salts of fatty acids, such as abietic acid, stearic acid, palmitic acid, lauric acid, oleic acid, linoleic acid and linolenic acid. The fats and unsaponifiable materials also contribute to the foam generation (3). Foam consists of bubbles which may be less than 1 um or more than 100 um in diameter; the latter are often called froth. If the system is unstable, the bubbles break, but if they are stable foam accumulates. Foam is carried by conditions which encourage the formation of bubbles when air is introduced through agitation (4). Troublesome foam practically never occurs with pure liquids but is generally caused by surface active materials which increase the concentration of dissolved substances in the interface. The foam with the smallest bubbles is usually the most stable and the most troublesome. 95% of foam volume consists of air and 5% of water. Foam has a very high surface tension viz 70 mN/m. (3).

There are usually two types of products used in paper industry for foam control such as antifoam and defoamers (5). Antifoam are the compounds used in early stage to control foam. The example of such types of compounds are polyglycol-fatty acids blends, phosphate esters, silicone types, metallic soap types, non-ionic fatty blends, polyglycol esters etc. The defoamers are also known as foam knock down which are used to reduce foam after generation.

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The example of such types of compounds are ether types, polyglycol-fatty acids blends, silicone types, alcohol types, vegetable oil types, fatty acid esters, polyglycol esters, emulsifiable pine oil etc.

In natural sulfite pulps the presence of chlorinated lignosulfonic acids in the pulp suspension considerably decreases the surface tension. The resin along with short ray cells of hard wood pulp are excellent foam stabilizers (6). In using clay as filler in ordinary, unsized magazine paper manufacture a small amount of foam is occasionally encountered. When carbonate filler ($CaCO_3$) is used, the foam is persistent and builts up as a heavy froth layer. The causes of foam was apart from any effervescent action of carbonate and any alum or acidic material which might be present.

Newsprints are generally produced from mechanical and semichemical pulps and chemimechanical pulps. Brightened chemimechanical pulps are also used for the production. Some amount of recycled fibres are also used. The raw materials used for production of newsprint besides hard wood and soft woods are bagasse, mesta, kenaf, bamboo, straw and other agricultural residues. The newsprints are generally unsized and sometimes loaded with calcium carbonate as filler materials. In production of newsprint the foam is created in the stock (7) system due to: (a) inadequatly washed chemical pulp, (b) excessive defoamers, alums etc., (c) excessive fresh water addition, and (d) varying head box pH.

The defoaming occurs either by a particle or a surface active agent interfering with the stable lamella (8, 9). For most aqueous foams the particle type has been found effective over the other. In this system the particles spreads out on the lamella on the outer surface of the foam. Since these particles are hydrophobic they push the water away from them thus creating a weak point at which the rupture occurs. Surface active agents have the same basic effect on the lamella. The doplets of insoluble liquid are spread on the lamella and form a bridge, which is similar to the particle defoaming. The difference in surface tension at the point of contact causes an unstable area in the lamella which leads to rupture.

EXPERIMENTAL

3 different old newspapers have been used for experimentation here which have been analysed (Table 1 and 2). The newspapers have been taken separately in a valley beater at consistency of 1, 1.4, 1.7 and 2.2% (without load). The total amount of slurry taken in the beater was 20 l.

Table-1.

Chemical analysis of newspapers used

Particulars	Newspaper I	Newspaper II	Newspaper III
A-B extractive, %	3.04	2.59	2.55
Ash, %	2.80	3.32	2.78

Table-2.

Microscopic analysis of fibres in newspapers

Particulars	Newspaper I	Newspaper II	Newspaper III
Avg. fibre length,mm.	1.35	1.15	1.27
Avg. fibre width,um.	16.3	16.9	16.0

5 different types of defoamers, easily available in the market have been used, termed in this paper as DFR-I, DFR-II, DFR-III, DFR-IV and DFR-V. The characteristics of defoamers are given in Table 3. Measured amount of defoamer were added directly to the Valley beater in running condition.

Table-3.

Characteristics of defoamers

Particulars	DFR-I	DFR-II	DFR-III	DFR-IV	DFR-V
pH	6.9	8.9	13.9	7.9	12.0
Solid content (Wt. %)	Nil	45.74	55.44	Thick viscous liquid	41.27
Solubility in water	Immiscible	Partially miscible	Miscible	Partially miscible	Miscible

RESULTS AND DISCUSSION

The reuslts of alcohol-benzene extractive of different newspapers are shown in Table 1. From the table it can be seen that the alcohol-benzene extractive percentage lies between 2.5 to 3% which

are on higher side, showing the presence of higher amount of resins, fatty acids and their esters and unsaponifiable substances. So it can immediately be inferred that foam is caused due to these substances. The ash content values (Table-1) are also on higher side (2.78 - 3.32%) indicating thereby that the presence of filler materials which might also be responsible for foam generation.

The fibre morphology study has been conducted by optical microscopy (Table 2). In the first newspaper, the fibre identification results show the presence of hard wood, soft wood and bagasse. Most of the pulp used in the above newsprint is mechanical, as confirmed by yellow colour after staining. From Table 2, it can be seen that the average fibre length is 1.35 mm, but most of the fibres are of hard wood origin. The average fibre width is 16.3 um. In the second newspaper, presence of large amount of vessels and short tapering end fibres was observed which indicates presence of hard wood and bagasse fibres respectively. Small amount of long and wide fibres indicates presence of fibres from soft wood origin. Most of these fibres are mechanical and some amount of chemical pulps are also present. The average fibre length is 1.15 mm with average fibre width of 16.9 um (Table 2). Presence of large number of vessels was identified in fibres of the third newspaper. Most of the fibres are from mechanical pulp. The average fibre length is 1.27 mm with width of 16.0 um (Table 2). Most of these fibres are of hard wood origin.

The defoamers differ both in pH (6.9 - 13.9) and solid content; the solubility in water is also found not to be the same for the five defoamers studied (Table 3). The chemical compositions are difficult to be found out and as the objective of this work was application-oriented, no effort was made for chemical analysis.

It was observed that the defoaming efficiency depends on:

(i) defoamer
(ii) concentration of defoamer
(iii) consistency of pulp and
(iv) pulp characteristics.

The volume of foam goes on increasing with increase in number of circulation in Valley beater. Practically no foam was observed when the newsprints are agitated with mechanical stirrer in a beaker.

The foam levels recorded for defoamer I and II at different concentrations with the 3 newspapers are presented in Fig. 1 - 6. The pulp consistency

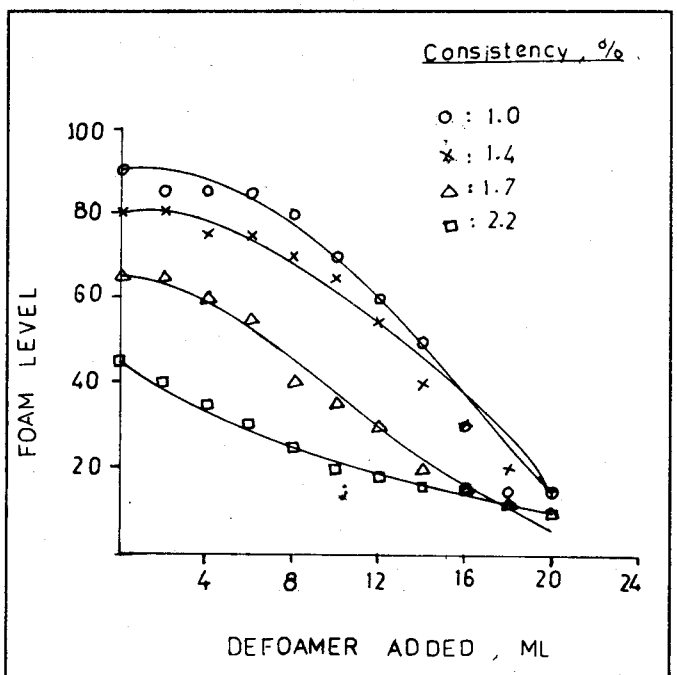

Fig.1: Defoaming of newspaper I with DFR-I

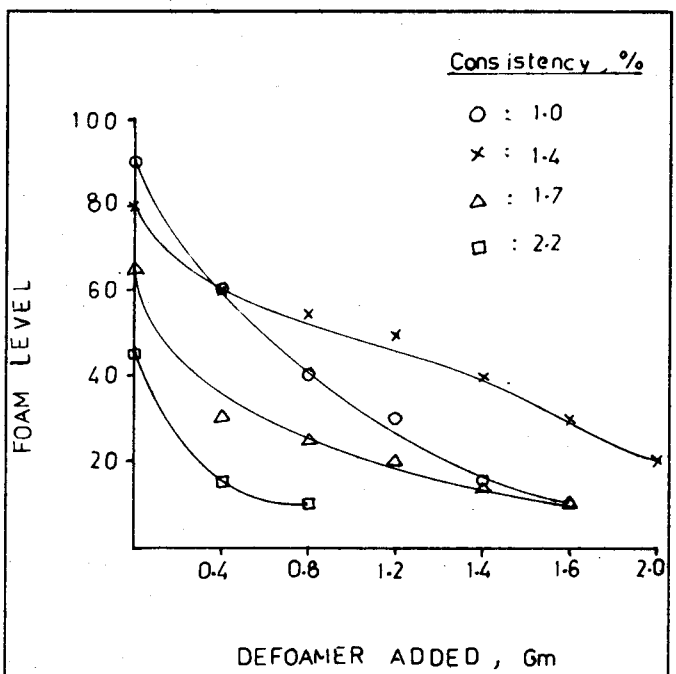

Fig.2: Defoaming of newspaper I with DFR-II

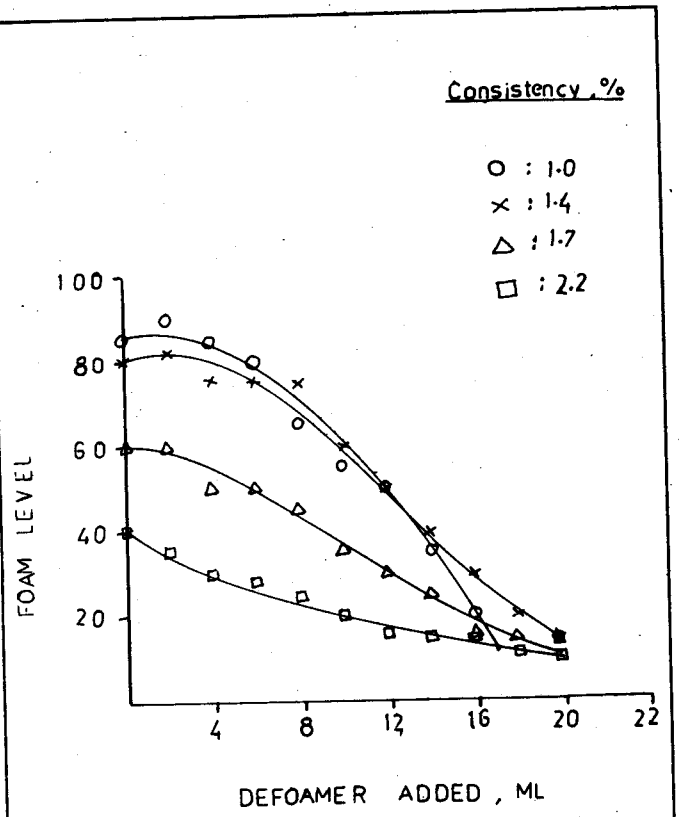

Fig.3: Defoaming of newspaper II with DFR-I

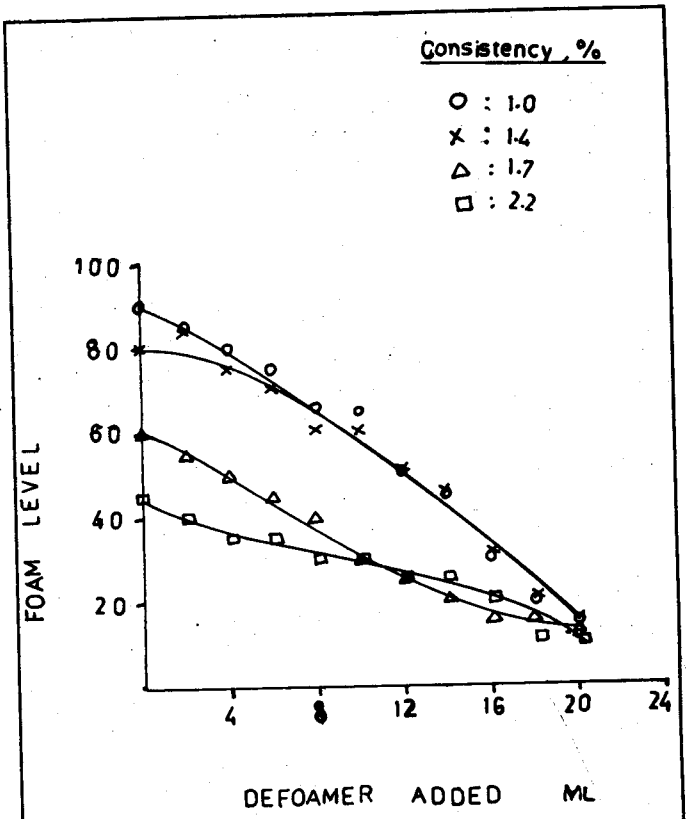

Fig.5: Defoaming of newspaper III with DFR-I

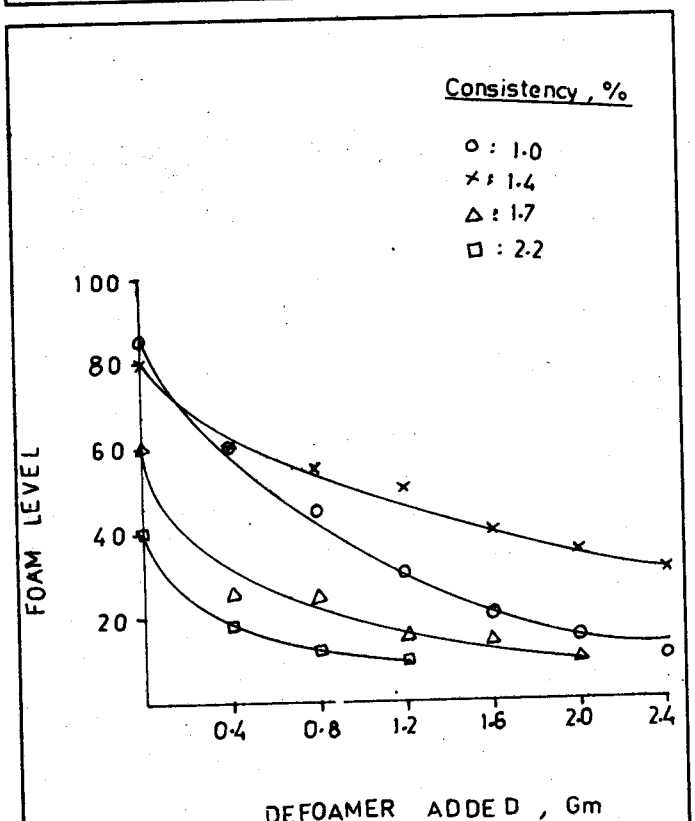

Fig.4: Defoaming of newspaper II with DFR-II

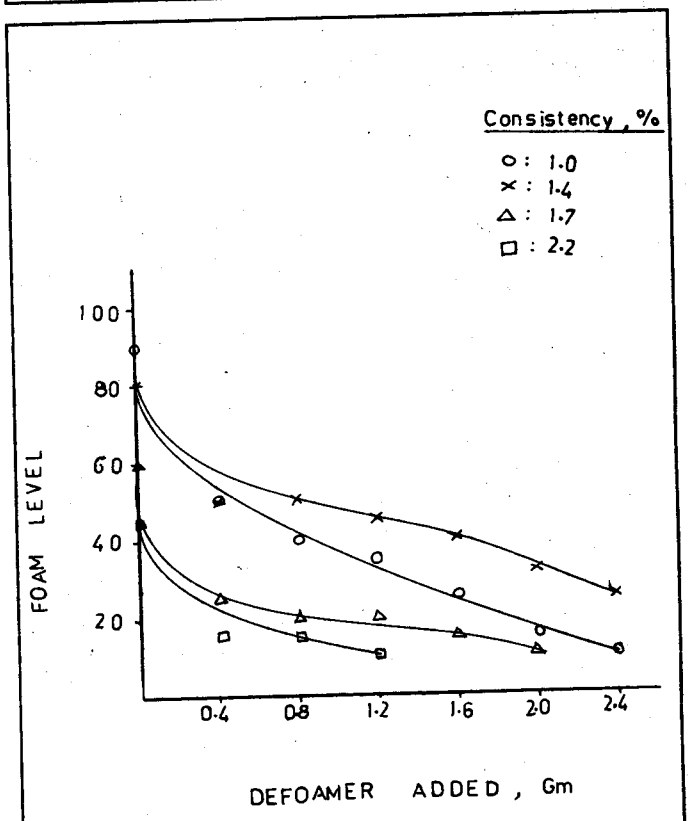

Fig.6: Defoaming of newspaper III with DFR-II

was maintained at 1, 1.4, 1.7 and 2.2%. The volume of foam was found to be more or less decreasing with increase in pulp consistency and defoamer concentration in all these cases. However, in case of defoamer II, the volume of foam generated is reversed at consistency of 1 and 1.4% i.e. consistency of 1.4% generates more of foam than at 1%. A thorough analysis of the curves will indicate that pulp consistency of 2.2% gives minimum amount of foam. Higher pulp consistency cannot be experimented in the beater. Defoamer I has been added by volume (in ml) while defoamer II has been added by weight (in gm). Around 10 ml of defoamer I and 1 g of defoamer II can be considered optimum for defoaming; the volume of pulp slurry being 20 l. Thus 0.5 ml/l of defoamer I and 0.05 g/l of defoamer II should be used at pulp consistency of 2.2%. In view of easy mixing action, the pulp consistency can be 1.4%.

The graphs plotted for defoamer III, IV and V at 4 - 20 ml defoamer concentrations for newprint I, II and III are shown in Fig. 7, 8 and 9 respectively at the optimum pulp consistency of 1.4%. Compared to defoamer I and II, the efficiency of these 3 defoamers is poor though defoamers V is better than III and IV; the decrease in foam volume

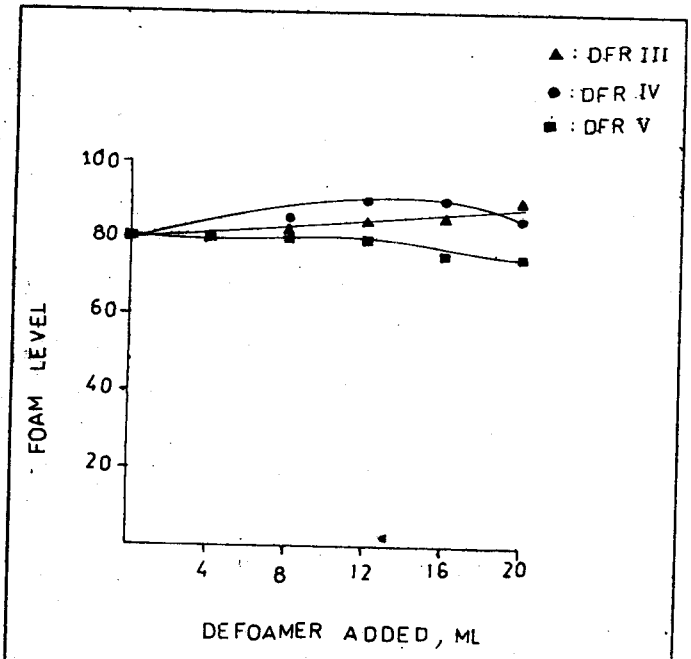

Fig.7: Defoaming of newspaper I with DFR-III, DFR-IV and DFR-V

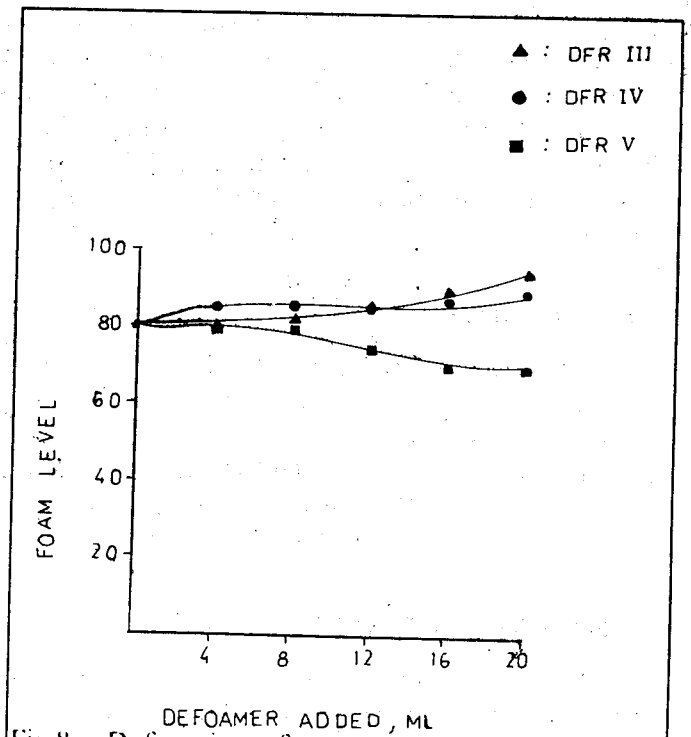

Fig.8: Defoaming of newspaper II with DFR-III, DFR-IV and DFR-V

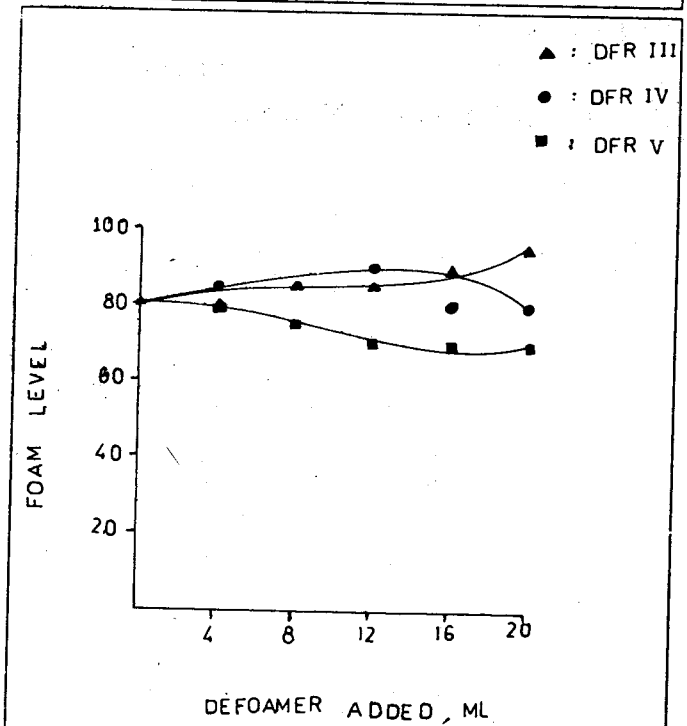

Fig.9: Defoaming of newspaper III with DFR-III, DFR-IV and DFR-V

in I and II is 8-10 times better than the defoamers III-V.

During beating process, it was observed that

the foam contains ink particles in substantial amount. On collection of the pulp after separation of the foam part, a pad was made and its brightness was measured to find the deinking action simply due to beating without use of any defoamer. The brightness of pad with foam was 24.8% El and pulp was 38% El.

CONCLUSION

The foaming problem of the newsprint can be minimised on use of defoamer. The optimum pulp consistency is 1.4%. Out of the 5 defoamers experimented, defoamer II (DFR-II) imparts the best defoaming action. The optimum defoamer concentration is found to be 0.05 g/l.

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