THE ACTION OF LIPOPHILIC UV ABSORBERS — SOLUBILIZED BY CYCLODEXTRIN — ON PHOTOFADING OF AQUEOUS SOLUTION OF AZOREACTIVE DYES

EDIT RÉMI[1], ÉVA FENYVESI[2], ISTVÁN RUSZNÁK[1],
ANDRÁS VÍG[3]
[1]*Technical University of Budapest, Department of Organic Chemical Technology, H-1111 Budapest, Műegyetem rkp. 3., Hungary*
[2]*CYCLOLAB Ltd., H-1525 Budapest, P.O.Box 435, Hungary*
[3]*Research Group of the Hungarian Academy of Sciences, TUB, H-1111 Budapest, Műegyetem rkp. 3., Hungary*

ABSTRACT

Two representatives of water-insoluble UV absorbers (3-(4-methylbenzilidene)-camphor and 2-hydroxy-4-methoxybenzophenon), different in their chemical structure, could be solubilized by two pairs of studied CDs (BCD, GCD, RAMEB, AcGCD). The substituted CD entities were markedly more effective solubilizers than the unsubstituted ones. The rate of photofading of an aqueous azoreactive dye solution was significantly increased in the presence of the substituted CDs. Mixing UV absorbers, solubilized by the mentioned CDs, to the aqueous dye solution marked deceleration in photofading could be achieved.

1. INTRODUCTION

The lightstability of azoreactive dyes, rather popular in dyeing, is generally only medium or poor [1]. The light-fastness of dyed textiles principally can be improved by various UV absorbers. The practical realisation of this is hindered by the water-insolubility of UV absorbers used in polymer protection on one hand, while on the other, water-soluble UV absorbers cannot be fixed on fibres permanently.
CDs can improve the aqueous solubility of a rather great variety of lipophilic molecules [2].

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The aim of the present work were as follows:

- solubilizing water-insoluble UV absorbers with CD-s
- application of the complex systems in improving lightstability of azoreactive dyes in aqueous solution.

2. MATERIALS AND METHODS

2.1 Materials

The used types CDs were: β-cyclodextrin (BCD), γ-cyclodextrin (GCD), acetyl-γ-cyclodextrin (AcGCD) and methyl-β-cyclodextrin (RAMEB). UV absorbers were: 3-(4-methylbenzylidene)-camphor (UV1) and 2-hydroxy-4-methoxybenzophenon (UV2). Hetero-bifunctional reactive azodye (RAD) of medium lightfastness was used in the experiments.

2.2. Measurement of the solubility of the UV absorbers in aqueous CD solutions

Excess amount (2 g/l) of UV absorbers was added to aqueous CD solutions of 1,25; 2,5; 5; 10; 20 g/l respectively. The stirring was continued at ambient temperature for 1 hour. The suspension was filtered through glass prefilter and the solution was tested spectrophotometrically after dilution with the 1:1 mixture of distilled water and ethanol.

2.3. The estimation of kinetics of photofading

UV absorbers were dissolved in the 20 g/l aqueous solution of AcGCD and RAMEB, respectively, and after filtration $5 \cdot 10^{-5}$ mole/l RAD was dissolved in the solution.
A photofading device with high-pressure mercury vapour lamp was used, and the changes in optical density were measured spectrophotometrically.

3. RESULTS AND DISCUSSION

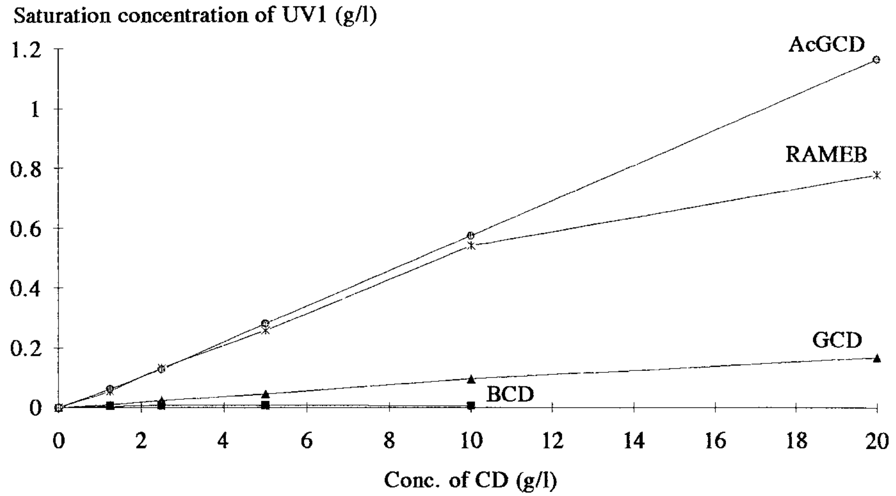

Fig. 1 Saturation concentration of UV1 in aqueous solution of different CD species

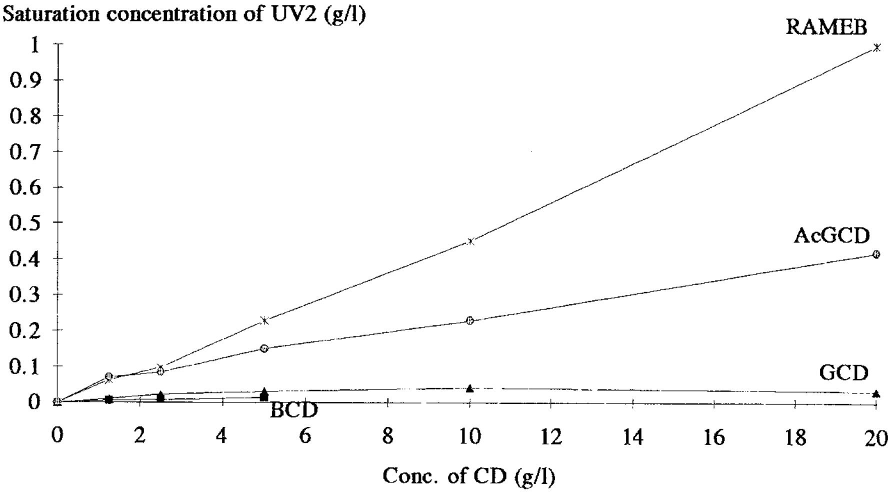

Fig. 2 Saturation concentration of UV2 in aqueous solution of different CD species

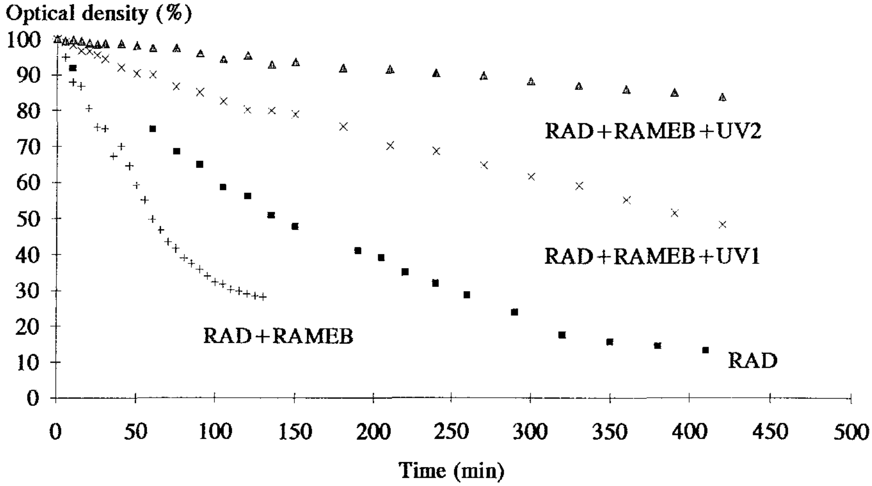

Fig. 3 Kinetics of photofading of RAD in aqueous solution (▪), influenced by the presence of RAMEB (+), RAMEB+UV1 (×) and RAMEB+UV2 (▲), respectively

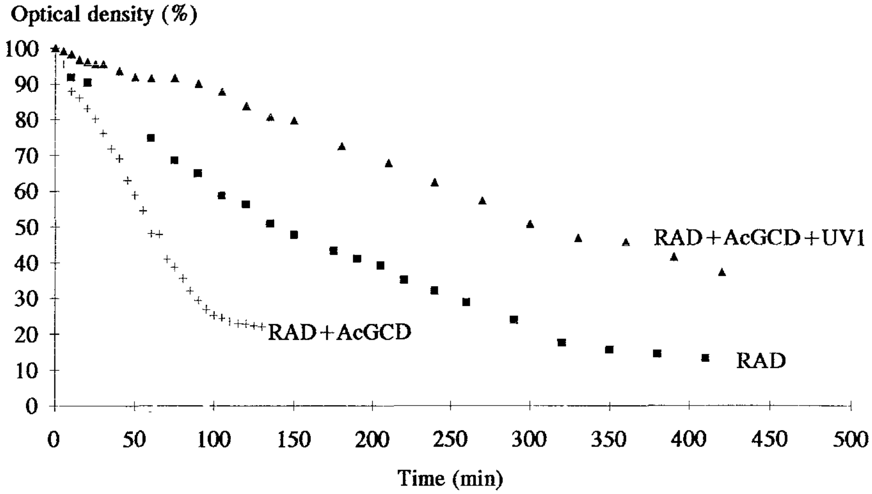

Fig. 4 Kinetics of photofading of RAD in aqueous solution (▪), influenced by the presence of AcGCD (+) and AcGCD+UV1 (▲), respectively

All the four studied CDs are effective solubilizing agents for the two investigated UV absorbers (Fig. 1, 2). Even with BCD 5, 1.5 fold increase in solubility of UV1 and UV2 was achieved, respectively. More UV absorbers can be solubilized by GCD than BCD. UV1 was the most efficiently solubilized by AcGCD, whereas UV2 by RAMEB (890, 110 fold, respectively). No correlation could be demonstrated between the solubility of two UV absorbers and the structural characteristic of studied CDs. Significant increase in solubility of both UV absorbers could be achieved by the substituted CDs than by the unsubstituted CDs.

Both substituted CDs (RAMEB, AcGCD) accelerated significantly the photofading of the dissolved dye when applied without (Fig. 3, 4). The combined systems including dissolved dye and UV absorbers solubilized by RAMEB or AcGCD generated significant deceleration in photofading of dye solution. The highest drop in rate of photofading (one tenth of the original one) could be observed by the application of UV2 solubilized by RAMEB. As AcGCD brought about significantly higher increase in the rate of photofading of the dye than RAMEB, it is obvious that deceleration in photofading caused by UV absorbers was more efficient in systems with RAMEB than those with AcGCD. (Remark: systems including RAD and UV2 solubilized by AcGCD could not be studied under exposure because unexpected precipitation occurred.)

4. CONCLUSION

The solubility of the UV absorbers can be significantly increased by CDs. The most effective solubilizers were AcGCD and RAMEB. Though the photofading of the azoreactive dye was accelerated by these CD derivativies, applying them as solubilizers of the UV absorbers a marked deceleration of photofading was observed.

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