KINETIC AND EQUILIBRIUM STUDIES OF
CYCLODEXTRIN-AZO DYE INCLUSION COMPLEXES

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CONTENTS

INTRODUCTION ............................................. 1

Bibliography ............................................. 10

CHAPTER I  HISTORICAL REVIEW

1.1 The Discovery of the Cyclodextrins ............ 13

1.2 The Determination of the Cyclodextrin
    Structure ........................................... 16

1.3 The Formation of the Cyclodextrins
    from Starch ........................................ 20

1.4 Cyclodextrin Inclusion Compounds ............. 24

Bibliography ............................................. 26

CHAPTER II  INCLUSION COMPLEX FORMATION

2.1 Detection of Complex Formation ................. 28

2.2 Thermodynamics of Complex Formation .......... 30

Bibliography ............................................. 44

CHAPTER III  EXPERIMENTAL TECHNIQUES

3.1 Temperature-Jump Relaxation
    Spectrophotometry .................................. 47

3.1.1 Principles of Chemical Relaxation ......... 48

3.1.2 The Temperature-Jump Method ............... 53

3.1.3 Experimental Procedure ...................... 58

3.1.4 Data Acquisition and Analysis ............. 59

3.1.5 Calibration of the Temperature Rise ...... 61

3.2 UV/Visible Absorption Spectroscopy ........... 63

3.2.1 Apparatus ..................................... 63

3.2.2 Experimental Procedure ...................... 65

cont'd...
CHAPTER III cont'd.

3.3 Circular Dichroism .................. 66
3.4 Linear Dichroism .................... 67
  3.4.1 Preparation of Films ............ 67
  3.4.2 Measurement of Spectra .......... 68
3.5 Fluorescence Spectroscopy .......... 69
Bibliography .......................... 70

CHAPTER IV  THE INTERACTION OF METHYL ORANGE WITH THE CYCLODEXTRINS

4.1 Introduction ........................ 71
4.2 Properties of the Methyl Orange Anion .... 79
4.3 The Interaction of Methyl Orange with α-Cyclodextrin ............... 88
  4.3.1 Results at pH 9.0 ............... 88
  4.3.2 Results at pH 13.4 ............. 93
4.4 The Interaction of Methyl Orange with β-Cyclodextrin ............ 99
  4.4.1 Results at pH 9.0 ............... 99
  4.4.2 Results at pH 13.4 ............. 106
4.5 The Interaction of Methyl Orange with γ-Cyclodextrin .......... 109
  4.5.1 Results at pH 9.0 ............... 109
  4.5.2 Results at pH 13.4 ............. 118
Bibliography .......................... 128

CHAPTER V  THE INTERACTION OF TROPAEOLIN WITH THE CYCLODEXTRINS

5.1 Introduction ........................ 131
5.2 Properties of the Tropaeolin Anion .... 132
5.3 The Interaction of Tropaeolin with α-Cyclodextrin ............... 140
  cont'd...
CHAPTER V  cont'd.

5.4 The Interaction of Tropaeolin with 
β-Cyclodextrin .......................... 140

5.5 The Interaction of Tropaeolin with 
γ-Cyclodextrin .......................... 145

5.6 The Interaction of the Tropaeolin 
Di-anion with the Cyclodextrins ...... 151

Bibliography ............................. 155

CHAPTER VI  THE INTERACTION OF ROCELLIN WITH 
THE CYCLODEXTRINS

6.1 Introduction .......................... 156

6.2 Properties of the Roccellin Anion ..... 156

6.3 The Interaction of Roccellin with 
α-Cyclodextrin .......................... 163

6.4 The Interaction of Roccellin with 
β-Cyclodextrin .......................... 166

6.5 The Interaction of Roccellin with 
γ-Cyclodextrin .......................... 168

6.6 The Interaction of the Roccellin 
Di-anion with the Cyclodextrins ...... 173

Bibliography ............................. 177

CHAPTER VII  GENERAL DISCUSSION AND CONCLUSIONS ..... 178

Bibliography ............................. 185

APPENDICES

A. Materials ............................. 186

B. Computational Methods ................ 188

C. Isosbestic Points ....................... 192

D. Molecular Exciton Theory ............. 195

E. Derivation of Reciprocal Relaxation 
Time Expressions ....................... 210

Bibliography ............................. 216
ABSTRACT

The cyclodextrins are cyclic oligosaccharides, which are able to form inclusion complexes with various organic molecules. The guest molecule is held within the hydrophobic cavity of the cyclodextrin by secondary forces alone. Whereas α-cyclodextrin is usually only capable of including a single guest molecule, it has been shown recently that the larger cyclodextrins, β and γ, are able to include two guest molecules simultaneously. This behaviour has been found for the series of azo dyes: methyl orange, tropaeolin and roccellin.

The presence of a guest dimer within the cyclodextrin cavity was detected by spectroscopic techniques: UV/visible absorption, induced circular dichroism and luminescence. The mechanism of one host-two guest complexation, given below, was determined by temperature-jump relaxation spectrophotometry.

\[
\begin{align*}
M + CD & \rightleftharpoons M \cdot CD \\
M \cdot CD + M & \rightleftharpoons M_2 \cdot CD
\end{align*}
\]

where \( M \) = dye monomer

\( CD \) = cyclodextrin

In the case of the dyes investigated, dimer formation within β- and γ-cyclodextrin occurs at dye concentrations at which the amount of dimer in free solution is negligible in the absence of cyclodextrin. Hence, β- and γ-cyclodextrin effectively increase the dimerisation constant of the dyes.
The ability of the cyclodextrins to include two guest molecules simultaneously has significance in the field of directed synthesis. It may be possible to use the cyclodextrins to facilitate the association of molecules, which could lead to an increase in the rate of certain reactions which the two molecules might undergo.