

## AMINES

### Synthesis, Properties and Applications

The understanding of amine chemistry is of paramount importance to numerous chemical industries, as well as to academic research. This book provides an authoritative account of the properties and applications of amines with respect to the characteristics of bonded substituents and the nature of their chemical and physical environments. The synthesis of alkyl, aryl and heterocyclic amines and inorganic amines with a review of their typical reactions is comprehensively treated, whilst practical synthetic and analytical methods for laboratory preparation and detection are provided. The importance of amine chemistry from the nineteenth century to the modern day, with a brief history of the development of ammonia synthesis, is included. This book is an invaluable reference source for undergraduates, postgraduates and chemical researchers working in industry.

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AMINES  
Synthesis, Properties and Applications

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## Contents

<i>Preface</i>	<i>page</i>	ix
1 An introduction to the amines		1
1.1 Introduction		1
1.2 Nitrogen		2
1.3 The history of ammonia and its importance to mankind		5
1.4 The chemistry of ammonia		18
References		23
2 Aliphatic, fatty and cyclic amines		25
2.1 The physical properties and geometries of amines		25
2.2 Aliphatic amines		33
2.3 Cyclic amines		55
2.4 Diamines and polyamines		62
References		68
3 Aryl amines		71
3.1 An introduction to aryl amines		71
3.2 Synthesis of (mono) aryl amines		74
3.3 Reactions of aryl amines		85
3.4 Aminophenols		100
3.5 Aryl diamines		104
3.6 Diaryl amines		109
3.7 Triaryl amines		116
References		117
4 Heterocyclic amines		119
4.1 An introduction to heterocyclic amines		119
4.2 Azirine		122
4.3 Aziridine (ethyleneimine)		123
4.4 Diazirene		129
4.5 Azetidine		130

vi	<i>Contents</i>	
4.6	Pyrrole	133
4.7	Pyrazole and imidazole	139
4.8	Fused five-membered nitrogen heterocycles	144
4.9	Pyridine	150
4.10	Pyrimidine, pyrazine and pyridazine	157
4.11	Quinoline, isoquinoline and quinolizine	162
4.12	Nitrogen-containing heterocycles with large rings	164
	References	167
5	Inorganic amines, hydrazine, hydroxylamine and amine ligands	169
5.1	Introduction to the inorganic chemistry of the amines	169
5.2	Chloramine	171
5.3	Nitrogen trichloride	174
5.4	Hydrazine	176
5.5	Hydroxylamine	185
5.6	Nitrogen-containing donor ligands	188
5.7	Nitrogen-containing macrocyclic ligands	194
5.8	Sulphur–nitrogen compounds	202
	References	204
6	Small-scale syntheses and analytical methods for amines	205
6.1	Introduction	205
6.2	Synthetic methods for alkyl and aryl amines	205
6.3	Amino-acid protection	215
6.4	The synthesis of heterocyclic amines	216
6.5	Analytical methods for amines	220
	References	234
7	Amine protection, amine oxides and amino acids	235
7.1	Amine protection	235
7.2	Amine oxides	245
7.3	Amines and amino acids	252
	References	262
8	Selected commercial applications of amines	265
8.1	Amines as corrosion inhibitors	265
8.2	Amines in pharmaceuticals	269
8.3	Amines as anti-cancer agents and DNA alkylators	274
8.4	Amines in the cosmetics and toiletries industries	278
8.5	The applications of amines in colour reprography	284
8.6	The applications of hydrazines	288
8.7	The applications of amines in agrochemicals	290
8.8	Azine and azo dyes	300
8.9	Indigo dyes	305
	References	306

	<i>Contents</i>	vii
Appendix 1	Molecular structures and isosurface electronic charges of selected amines	309
Appendix 2	Physical properties of selected amines	315
Appendix 3	Named reactions involving amines	317
	<i>Index</i>	361

## Preface

Much of the chemistry of the amines was discovered in the nineteenth century by pioneering chemists such as Hofmann, Leuckart, Gabriel and Knoll. The introduction of the Cyanamide Process and Electric Arc Process at the beginning of the twentieth century made amines commercially available for the first time at low cost and no longer an academic curiosity or restricted for use only in high-value products. However, the implementation of the Haber–Bosch Process at Leuna in Eastern Germany in 1917 marks the beginning of the modern age of amine chemistry.

Having worked with amines for many years, both on a small scale in the laboratory producing gram quantities of novel amines and also on a larger scale on full-sized manufacturing plants producing several hundred tonnes per year of amine-based pharmaceutical intermediates, it has always been a problem for me that I could never find a single, up-to-date, resource book specifically dedicated to the synthesis, properties and reactions of amines. The most recent examples that I was able to find that cover the whole area of amine chemistry were David Ginsburg's *Concerning Amines*, which dates from 1968, and the third edition of Neville Sidgwick's *The Organic Chemistry of Nitrogen* (first published in 1910 but revised in 1966 by I. T. Miller and H. D. Springham), although most general organic chemistry books contain a chapter or two on amines. Eventually I decided that the best way to rectify this situation would be for me to write such a book, and so this was my reason for approaching Cambridge University Press, who agreed to my proposal. It is my hope that the readers of this book will find that it contains the answers to many of their unanswered questions about amines and also provides suitable references for further study.

This book contains eight chapters and three appendices. Chapter 1 reviews the history and properties of ammonia and nitrogen. Chapters 2 and 3 are concerned with the properties, syntheses and reactions of alkyl and aryl amines respectively. Heterocyclic amines are found in Chapter 4; inorganic amines including macrocyclic ligands are the subject of Chapter 5, and Chapter 6 contains some laboratory

synthetic routes to amines and also details of analytical procedures. Amine oxides, protected amines and amino acids are reviewed in Chapter 7, and Chapter 8 covers the applications and commercial uses of amines. At the end of the text there are three appendices, which shown the structures and isosurface electronic charges of some amines (Appendix 1), a table of the physical properties of selected amines (Appendix 2) and the named reactions and named syntheses of amines (Appendix 3).

The reader's attention is drawn to the safety advice given in, for example, Section 6.1. Some of the chemicals mentioned in this book are dangerous, and although the author can vouch that the experiments described do work, if properly conducted, neither he nor the publisher will be liable for accidents that may take place in the course of experimentation!

I would like to thank Frau Urte Thiele and Dr Klaus Baehr of Chemtec Leuna for the photographs of the plant at Leuna, and also Inegard Rafn and Kai Evensen of Norsk Hydro for the photographs of the plant and laboratories at Notodden in Norway.

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