ISSN: 2456–5474 RNI No.UPBIL/2016/68367 Vol.-6* Issue-1* February- 2021
Innovation The Research Concept

A Brief Review on Applications of Azo Compounds

Paper Submission: 11/02/2021, Date of Acceptance: 22/02/2021, Date of Publication: 23/02/2021

Manju Meena
Assistant Professor,
Dept. of Chemistry,
R.R. Govt. College,
Alwar, Rajasthan, India

Abstract

In this review paper we talk about dyes are used to give colors to substances, especially fabrics. Chromophores functional groups that absorb light, give color to these dyes. Azo dyes have a nitrogen nitrogen double bond as their chromophore. we are going to discuss about brief review on applications of azo compound.

Keywords: Azo, Diazonium, Polymerization, Tautomer, Hydrazones, Biological Application, Chromophore

Introduction

Azo compounds are important class .There are different uses of azo compounds. we are going to discuss about brief review on application of azo compounds.

Azo dyes represents the largest production volume of dye chemistry today and their relative importance may even increase in the future.Azo compounds are a very important class of chemical compounds which have received continuous attention in scientific research. These derivatives are highly colored and have been used as dyes and pigments for a long time.

Organic compounds with the functional group R-N=N-R' in which R and R' can be either aryl or alkyl groups are termed as azo compounds i.e. any organic compound with an azo linkage (−N=N−) in its molecular structure is representative of this class of compounds. In the IUPAC system azo compounds are considered derivatives of diazene (diimide), HN=NH, having both hydrogen atoms substituted by hydrocarbyl groups, e.g. PhN=NPh azobenzene or diphenyldiazene.[1] The name azo comes from ‘azote’, the French name for nitrogen which has been derived from the Greek ‘a’ (not) + ‘zoe’ (to live). Azo compounds containing aryl groups are generally observed to be the more stable derivatives. Commercially important azo compounds which are mainly used as dyes [2-5] are aromatic derivative and are generally known as aromatic azo compounds.
The simplest method for the preparation of an aromatic azo compound is a coupling reaction between a diazonium salt and an organic molecule having a C-site with an easily replaceable hydrogen atom [6,7]. Other methods have also been used for the preparation of azo compounds [8-10].

Aliphatic azo compounds are usually prepared by dehydrogenation of the corresponding hydrazo derivatives i.e. compounds with a −HN−NH− group [11-12]. Aliphatic azo derivatives (R and/or R' = aliphatic) are relatively less common than their aryl azo analogues as they are less stable [13-15] e.g. diethyldiazene, EtN=NEt. [16] is highly unstable and explosive but azobenzene PhN=NPh is stable. Most alkyl azo compounds are thermally ustable and some undergo thermal fragmentation to nitrogen and free radicals [17-18].In many cases the free radicals generated in the decomposition are used to initiate polymerization reactions.

Azo dyes aquired wide interest in application to biological system and indicator in complexometric titration of analytical chemistry.Azo dyes are the most important group of synthetic colorants .They are generally considered as xenobiotic compounds that are very recalcitrant against biodegradative processes.These derivatives are highly coloured and have been used as dyes and pigments for a long time [19-21]. Due to their excellent thermal and optical properties they are also useful in other

applications as optical recording medium [3−6], toner [7,8], ink-jet printing [9,10], and as oil-soluble lightfast dyes.[22-29].

Aromatic azo compounds accounts for ~50% of all dyes, they all have an azo group, -N=N-, linking two sp^2 hybridised carbon atoms which are a part of the aromatic system. Azo dyes generally contain only one azo group but some dyes containing two (disazo), three (trisazo) or more [30] azo groups are also known.

In theory, azo dyes can impart a complete range of colors. However, commercially such dyes are most abundant in yellow, orange red and some blue shades [31]. The color of aromatic azo dyes is consequence of π-delocalization. The color changes in these dyes are caused by variations in the extent of delocalization of electrons: higher delocalization result in a shift of the absorption max to longer wavelengths making the light absorbed redder, while lesser delocalization shifts result in a shift of the absorption max to shorter wavelengths. Color changes can also be due to geometrical isomerism because of the azo group. UV radiation may induce a *trans* azo group to become *cis* resulting in photochromism, a light-induced reversible color change. Azo dyes with the property of reverting slowly to the *trans* isomer in the dark are used in sunglasses and car sunroofs. Many azo dyes, like Sudan red and scarlet red are useful as biological dyes as they are fat-soluble and can be absorbed by fat cell tissues [32,33].

Besides dyes azo pigments are also important in the paint industry. Azo pigments are colorless particles generally of earths or clays colored with an azo compound. They have good light fastness and excellent coloring properties. The light fastness of these pigments depends on the properties of the organic azo compound and their absorbtion on the pigment carries [34].

In recent years, arylazo derivatives of various heterocyclic systems have been the subject of renewed research for chemists [35] and dye manufactures [36]. The potential utility of these derivatives in the field of material sciences has also been reported [37]. Heterocyclic azo compounds have been used in textile and plastics industries, biological-medical studies and in organic synthesis [38]. These compounds are also used in various other fields as, printing, electronic photography, color formers, liquid crystal displays, laser technology, data storage and solar energy conversion [39]. Some heterocyclic dyes have been identified as non-linear optical (NLO) materials. They have potential use in optical communications, information processing, frequency doubling and integrated optics [40].

Work on synthesis and tautomeric structures of arylazo-heterocycles[41-49] has also been pursued, as these compounds can exist in several tautomeric forms. The main interest of these investigations is to ascertain their stable tautomeric forms as this is useful to probe their potential utility. The knowledge of the actual tautomeric form(s) of azo dyes in solution and the solid phase is important for their industrial and biological applications. The bioactivity of azo compounds with heterocyclic systems have been evaluated and it has been observed that heterocyclic azo derivatives show interesting biological activity as antimicrobial [50-53, 64], analgesic [54], anti-inflammatory [55] and anti-cancer [56,57] agents.

Metal complexes of azo ligands have also attracted attention due to their interesting electronic and geometrical features and their application for molecular memory storage, nonlinear optical elements, and printing systems.[38,40, 46].

Presently work on the negative effects of azo dyes on human health and the environment is a subject of intense research.Dyes are complex colour structure and highly visible even at lower concentrations and having adverse effects on aquatic life. Thionine- based textile dye, azo dyes, textile dyes and congo red are well known dyes that are hazardous and carcinogenic in nature. These dyes enter into the body through ingestion and cause bladder cancer and DNA diseases. These dyes not only affect the marine environment but also dangerous for a human being.These pollutants (heavy metals and organic dyes) enter into the water bodies and contaminate aquatic systems which are becoming a global environmental issuse. From the aquatic system, these pollutants enter into the food chain of human and other organisms through biological and geochemical mechanisms. These pollutants are very toxic and persistent in nature. The other topic of research that is being actively perused is to develop methods and technologies for the removal of azo dyes and related compounds in the industrial discharge waste and from the environment [58-63].

Conclusions

Based on the above information about the biological and analytical application of hydrazones it is concluded that the hydrazones are precious reagents in the determination of metal ions in various environmental matrices. It is very useful to the future studies in this respect.

References

1. *IUPAC, Compendium of Chemical Terminology, 2nd ed. (1997).*
2. *P. F. Gordon, P. Gregory, Organic Chemistry in Colour, Springer-Verlag, Berlin (1983).*
3. *O. O. Ajani, O. E. Akinremi, A. O. Ajani, A. Edobor- Osoh and W. U. Anake, Physical Review & Research International, 3(2013) 28.*
4. *L. A. R. Al-Rubaie, R. J. Mhessn, E. J. Chem., 9 (2012) 465.*
5. *P. Rys, H. Zollinger, Fundamentals of the Chemistry and Application of Dyes. London, Wiley (1972).*
6. *J. Griffiths, Developments in the Chemistry and Technology of Organic Dyes, Oxford, Blackwell (1984).*
7. *H. Zollinger, Color Chemistry, Weinheim, Verlag Chemie (1987).*
8. *R. D. Little, M. G. Venegas, J. Org. Chem., 43 (1978) 2921.*
9. *M. Zhang, R. Zhang, A. Zhang, X. Li, and H. Liang, Synthetic Communications, 1 (2009) 3428.*
10. *R. A. Zarkesh, J. W. Ziller, A. F. Heyduk, Angew. Chem. Int. Ed. Engl., 47 (2008) 4715.*

11. *M. I. Javed and M.Brewer, Org. Lett., 9 (2007)1789.*
12. *L. Zhang, J. Xia, Q. Li, X. Li, and S. Wang, Organometallics, 30 (2011) 375.*
13. *A. F. Bickel and W. A. Waters, Recueil des Travaux Chimiques des Pays-Bas, 69 (1950) 312.*
14. *A. F. Bickel and W. A. Waters, Recueil des Travaux Chimiques des Pays-Bas, 69 (1950)1490.*
15. *D. Lím, Collect. Czech. Chem. Commun., 33 (1968) 1122.*
16. *R. Ohme, H. Preuschhof, H. U. Heyne, "Azoethane". Org. Synth. Coll., 6 (1988) 78.*
17. *A. Staško, K. Erentová, P. Rapta, O. Nuyken and B. Voit, Magnetic Resonance in Chemistry, 36 (1998) 13.*
18. *M. Procházka, O. Ryba and D. Lím, Collect. Czech. Chem. Commun., 36 (1971) 2640.*
19. *R. G. Jones, N. Khalid, European Polymer Journal, 18 (1982) 285.*
20. *R. Hamprecht and A. Westerkamp, Ullmann's Encyclopedia of Industrial Chemistry, 10 (2003) 573.*
21. *H. Klaus, Industrial Dyes, Chemistry, Properties, Applications. Wiley-VCH, Weinheim (2003) 20.*
22. *H. E. Katz, K. D. Singer, J. E. Sohn, C.W. Dirk, L. A. King and H. M. Gordon, J. Am. Chem. Soc., 109 (1987) 6561 .*
23. *T. Abe, S. Mano, Y. Yamada and A. Tomotake, J. Imag. Sci. Tech., 43(1999) 339 .*
24. *24 T. Chino, M. Yamada, JP 2001220519 (2002).*
25. *S. Wang, S. Shen and H. Xu, Dyes Pigments, 44(2000) 195.*
26. *K. Maho, T. Shintaro, K. Yutaka, W. Kazuo, N. Toshiyuki and T. Mosahiko, Jpn. J. Appl. Phys., 42(2003) 1068 .*
27. *D. W. Rangnekar, V. R. Kanetkar, J. V. Malanker and G. S. Shankarling, Indian J. Fiber Text. Res., 24(1999)142.*
28. *G. Hallas and J.H. Choi, Dyes Pigments, 40(1999) 119.*
29. *P. Gregory, D. R. Waring and G. Hallos, 'The Chemistry and Application of Dyes', Plenum Press, London (1990) 18.*
30. *S. S. Kandil, Trans. Met. Chem., 23(1998) 461.*
31. *D. M. Marmion, Hand book of Colorant, Wiley New York (1999) 23.*
32. *R. Ambrósio Jr., H. Ahmad, D. Caldas, A. L. C. Canedo, B Valbon, F. P. Guerra, A. A de S. Lima, 70 (2011) 408.*
33. *W. Hiebl, B. Gunther, H. Meinert, Klin Monbl Augenheilkd. Rev Bras Oftalmol., 222 (2005)309.*
34. *R. M. Christi, R. R. Mather and R. H. Wardman," The Chemistry of Color Application." Blackwell Science Ltd: Oxford, (2000) 13.*
35. *K. Takagi, A. Mizuno, H. Iwamoto, S. Kawashima, S. Nishida, and T. Hashikawa, Dyes Pigments, 26 (1994) 51.*
36. *Y. M. ElKholy, S. A. Abda El-Hfiz, Pigment Resin Technol, 23 (1994) 3.*
37. *A. S. Shawali, M. H. Abdelkader, F. M. A. Eltalbawy, Tetrahedron, 58 (2002) 2875.*
38. *I. Sener, F. Karci, N. Ertan, E. Kilic, Dyes Pigments, 70 (2006) 143.*
39. *G. S. Uscumlic, D. Z. Mijin N. V., Valentic,V. V. Vajs, B. M. Susic, Chem Phys Lett., 397 (2004) 148.*
40. *M. M. M. Raposo, A. M. R. C. Sousa, A. M. C. Fonseca, G. Kirsch, Tetrahedron, 61 (2005) 8249.*
41. *A. S. Shawali, T. A. Farghaly, Tetrahedron, 60(2004) 3051.*
42. *A. S. Shawali, M. A. N. Mosselhi, T. A. Farghaly, J. Chem. Res., (2007) 479.*
43. *A. S. Shawali, S. M. Sherif, T. A. Farghaly, M. R. Shehata, M. A. A. Darwish, J. Chem. Res., (2007) 44.*
44. *A. S. Shawali, M. A. Mosselhi, F. M. A. Altablawy, T. A. Farghaly, N. M. Tawfik, Tetrahedron, 64(2008) 5524.*
45. *T. A. Farghaly, Z. A. Abdallah, Arkivok, (xvii) (2008) 295.*
46. *T. A. Farghaly, M. M. Abdalla, Bioorg. & Med. Chem., 17(2009) 8012.*
47. *T. A. Farghaly, A. S. Shawali, J. Chem. research, 36 (2012) 296.*
48. *T. A. Farghaly, M. M. Edrees, M. A. N. Mosselhi, Molecules, 17(2012) 8483.*
49. *T. A. Farghaly, H. K. Mahmoud, Arch. Pharm. Chem. Life Sci., 346 (2013) 392.*
50. *K. C. Liu, Zhonghua Yaoxue Zazhi, 40 (1988)203.*
51. *R. M. Claramunt, J. Dotor, J. Ann. Quim, 91 (1995) 151.*
52. *W.; Scriven, E. F. V. Eds., Pergamon, Oxford, 6 (1986).*
53. *D. Sharma, B. Narasimhan, P. Kumar, V. Judge, R. Narang, E. De Clercq, J. Balzarini, Eur. J. Med. Chem., 44 (2009) 2347.*
54. *K. C. S. Achar, K. M. Hosamani, H. R. Seetharamareddy, Eur. J. Med. Chem., 45 (2010) 2048.*
55. *A. Puratchikodya, M. Doble, Bioorg. Med. Chem., 15 (2007) 1083.*
56. *Y. Morita, S. Suzuki, K. Fukui, S. Nakazawa, H. Kitagawa, H. Kishida, H. Okamoto, A. Naito, A. Sekine, Y. Ohashi, M. Shiro, D. Sasaki, D. Shiomi, K. Sato, T Kitagawa, T. Takui, K. Nakasuji, Nat. Mat., 7 (2008) 48.*
57. *Y. Morita, K. Aoki, S. Nakazawa, K. Tamaki, S. Suzuki, A. Fuyuhiro, K. Yamamoto, D. Shiomi, A. Naito, T. Takui, K., Nakasuji, Angew. Chem. Int. Ed., 41 (2002) 1793.*
58. *Bruna de Campos Ventura-Camargo and Maria Aparecida Marin-Morales Industrial Science and Technology (TLIST), 2 (2013).*
59. *S. T. Ambrosio, Campos-Takaki, G. M. Bioresour. Technol., 91 (2004) 69.*
60. *M. M. Zhang, C. T. Chang, Y. Ding, K. L. Lin, C. S. Chiou, C. C. Hsueh, H. X. Bioresour. Technol., 101 (2010) 4737.*
61. *J. Sereikaite, V. Bumelis, Cent. Eur.J. Chem.,6 (2008) 509.*
62. *Y. Mu, K.Rabaey, R. A. Rozendal, Z. Yuan, J. Keller, Environ. Sci. Technol., 43 (2009) 5137.*
63. *R. Anliker, Organic Colorants—Interpretation of Mammalian, Genus and The Royal Society of Chemistry, London, UK,(1986)166.*