



## Ion Exchange: Primeval Yet Cutting-Edge Process

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### Article History

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Ion exchange is a process in which ionic species in the liquid phase tend to swap with the ions present in the insoluble solid phase (ion exchanger) with fixed ionic sites.<sup>1</sup> In ancient time there was an acceptance of the principle which states “Copura non agunt nisi fluida sive soluta” ie precursors should be in fluid or dissolved state for any reaction to occur.<sup>1</sup> However this old adage has been challenged by ion exchange process as it involves a heterogeneous phase. Ion exchange is an antediluvian process that is prevalent from primordial periods of mankind. There have been substantial scientific developments ever since its first mention in the Bible which talks about Moses removing bitterness from water in 1400 BC. This was affirmed by Aristotle in 330 BC, who realized that saltiness of seawater reduced once it passed through sand. Much later in 1845, H. S. Thompson found ammonia was separated from manure solution using a garden soil filter. This process was attributed to ion exchange behavior of zeolites present in soil by H. S. Thompson, J. T. Way and J. Spence during 1848–1852. After six years (1858), H. Eichorn evinced this process to be reversible. In 1876, base exchange using zeolites was proved by J. Lemberg. During 1901-1902, synthetic ion exchangers were available for the first time. In 1905, R. Gans used zeolite for water softening and recovery of gold from seawater. O. Folin and R. Bellin in 1917 demonstrated the analytical application of ion exchange while six years later (1923) J. Whitehorn developed ion exchange column separations O. Leibknecht's (during 1934-1939) developed cation exchangers for sodium and hydrogen cycles. Though organic resins were synthesized by B. A. Adams and E. L. Holmes during 1934–1935, it took more than 7 years (1942) for invention of sulphonated polystyrene based cation exchangers by G.F. D'alelio. In the same year, G. E. Boyd, J. Schubert, and A. W. Adamson successfully demonstrated the adsorption of trace amounts of fission products. Amine based anion exchange resins and potassium-specific polystyrene cation—exchanger chelating resins were invented by C. H. Mcburney and A. Skogseid respectively in 1947. During 1949-1956 J. A. Marinsky, L. E. Glendenin, and C. D. Coryell discovered carboxylato group based weak cation exchange resins while R. M. Barrer and D. W. Breck identified the ion exchange property of new zeolites.

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In 1952 M. A. Peterson and H. A. Sober developed cellulose ion exchangers while in 1956, F. Helfferich gave the theoretical aspect and identified capacity to be a term to compare the efficiency of different ion exchangers. For the next twenty years the extensive work of H. P. Gregor, K. W. Pepper, and L. R. Morris lead to synthesis of chelating polymers while. laid the foundation laid for the new theoretical treatment of ion exchange. Within a year, T. R. E. Kressmann and J. R. Millar developed isoporous ion exchange resins and finally J. Weissset paved the way for desalination techniques.<sup>2</sup> Ion exchange property is affected by many factors which have been studied in detail.<sup>3</sup> It is seen that shelf life plays a great role on the capacity as it affects the water structure within the ion exchanger.<sup>4</sup> Ion exchanger resin is useful for analysis of anions in Ion chromatography.<sup>5</sup>

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