

## Sulfamic Acid and Its Derivatives

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Sulfamic acid,  $\text{H}_2\text{NSO}_3\text{H}$ , is related structurally to sulfuric acid and may be looked upon as a mixed ammonio aquo sulfuric acid. It is a white, crystalline, non-hygroscopic solid, melting with decomposition at  $205^\circ$ . It is only moderately soluble in water and may be purified by recrystallization from cold water. In aqueous solution the acid is highly ionized.

Sulfamic acid has been investigated for use as a primary standard of reference. It is superior in this respect to such acid standards as constant boiling hydrochloric acid, potassium acid iodate, potassium acid phthalate and benzoic acid. A wide variety of indicators over a pH range of 5 to 9 may be used in standardizing bases with sulfamic acid.

Sulfamic acid is very soluble in liquid ammonia, being converted into the ammonium salt. Sulfamic acid acts as a dibasic acid in liquid ammonia.

Amine salts of sulfamic acid may be prepared by interaction of the amines in aqueous or alcoholic solution with sulfamic acid. These are stable crystalline solids, differing in some instances from the inorganic salts by the fact that they are somewhat hygroscopic.

Alkyl and aryl sulfamic acids are most conveniently obtainable by interaction of the amines with chlorosulfonic acid. Preparations of this type must be carried out in non-aqueous solvents such as dioxane, chloroform, and carbon tetrachloride. Derivatives of N-disubstituted and N-monosubstituted acids,  $\text{R}_2\text{NSO}_3\text{H}$  and  $\text{RNH}\cdot\text{SO}_3\text{H}$ , have been prepared and their properties investigated.

Convenient laboratory methods for the preparation of free sulfamic acid include (1) the hydrolysis of nitrosulfonates, and (2) action of sulfur dioxide on hydroxylamine salts or acetoxime. Commercially, sulfamic acid is prepared by the action of fuming sulfuric acid upon urea. The introduction of this method has made sulfamic acid really available on the market, at a price where it should find wide use and application in synthetic and analytical chemistry.