in 30 ml of acetic acid. The temperature was increased from 20 to 48°C. The solution was stirred at room temperature for 2 h; 3 g of sodium sulfite was added and the reaction mixture was refluxed for 2.5 h. The cooled solution was diluted with 80 ml of water. The resulting precipitate was filtered, washed with 50% aqueous acetic acid and then water to neutral reaction, and dried. Yield 1.4 g of V. Similarly 1 g of IIIb yielded 0.41 g of V.

**LITERATURE CITED**


**METAL CANS IN AEROSOL PACKINGS**

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In foreign pharmaceutical practice wide use is made of metal cans for aerosol preparations as well as glass cans. As examples we cite such preparations as the antiallergic alypent (Yugoslavia), novodrin spray (East Germany), the film-forming plastubol (Hungary), the inhalation nasivin (West Germany), ventolin (Britain), decatricina (Italy), and the dermatological sofradex and acidocort (France).

Metal cans are manufactured from steel and aluminum. The most efficient are considered to be monoblock aluminum cans, which are manufactured by successive drawing from slugs. These cans have a number of advantages over tin plate or composite aluminum cans: They are hermetic, display high resistance to impact and pressure, are light, and have a good external appearance.

![Fig. 1. Internal surfaces of aluminum cans after contact with a Freon-12/ethyl alcohol/water system; a) with tin valve; b) with aluminum valve.](image)

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Fig. 2. Pinhole corrosion of the internal surface of an aluminum can after contact with an ethyl alcohol/Freon-11 and Freon-12 (1:1) system.

Fig. 3. Uniform corrosion of the internal surfaces of an aluminum can after contact with Dermazol' preparation (acid system with 1:1 Freon-11 and Freon-12).

Aluminum possesses quite high anticorrosion properties because of its self-passivity; however, on contact with some medicinal agents it still suffers corrosion.

The corrosion of aerosol packings can be the result of electrochemical or chemical reactions during interaction of the contents with the can's internal surface.

Sometimes two different metals are used in aerosol packings (the valve dome is manufactured from tin plate and the can from aluminum), though it is known that contact of two metals with different electrode potentials in the presence of an electrolyte initiates an electrochemical reaction. In the tin-aluminum couple in aerosol packings dissolution of the aluminum occurs, since its electrode potential is more negative. Hence with electrically conducting contents of the can the aluminum is attacked, forming holes (Fig. 1).

The most typical form of corrosion of aluminum as a self-passivating metal is pinhole corrosion (Fig. 2). However, contact with particularly active products (water and acids) sometimes produces relatively uniform corrosion, which is intensified in the liquid phase (Fig. 3).

On aluminum at gaps in the oxide film, point corrosion sites (anode) are formed, while the entire remaining surface of the metal covered with the film functions as the cathode. The combination of a point anode and relatively large cathode causes strong corrosion of the anodic parts, since the hydrogen evolved during electrochemical corrosion at the large-surface cathode becomes more mobile and more easily reacts with oxygen [1]. Removal of the hydrogen gives rise to depolarization, which is conducive to the development of corrosion. Pinhole corrosion is extremely dangerous to the aerosol packing, since the appearance of even one hole in the can wall puts the packing out of commission.

The process of corrosion in aerosol packings depends on a multiplicity of factors: the type of propellant used, moisture content, alcohol, oxygen, acids, aldehydes, halogen ions, chemical composition of the aluminum, properties and pretreatment of the can's surface, storage conditions, etc. [2-4].

The usual propellants in pharmaceutical aerosols are chlorofluorohydrocarbons (Freons), derived from methane, ethane, and cyclobutane, because of their compatibility with many organic substances, chemical inertness, and nontoxic nature [5, 6]. They differ considerably from each other in terms of their chemical reactivity, on which the stability of the Freon/medicinal agent/aluminum system depends. Freon-12 (dichlorodifluoromethane), Freon-14 (dichlorotetrafluoroethane), and Freon C-318 (octafluorocyclobutane) are distinguished by high stability. Freon-11 (trichlorofluoromethane) also possess a number of favorable properties (the best solvent of all the Freons), but it is extremely reactive in alcohol, water/alcohol, and aqueous systems and gives rise to intense electrochemical corrosion in metal packings. For oleaginous systems and water-in-oil emulsions Freon-11 can be used in aluminum cans that have protective anticorrosion polymeric linings. Aerosols