Guidelines EN-G14: Secondary Aluminum Works

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1. Introduction

Hydrochloric acid (HCl) is a versatile chemical that has a number of different industrial uses. Some examples are hydrometallurgical processing (e.g., production of alumina and/or titanium dioxide), chlorine dioxide synthesis, hydrogen production, activation of petroleum wells, and miscellaneous cleaning/etching operations including metal cleaning (e.g., steel pickling). Also known as muriatic acid, HCl is used by masons to clean finished brick work. Hydrochloric acid is also a common ingredient in many reactions and is the preferred acid for catalyzing organic processes. One example is a carbohydrate reaction promoted by hydrochloric acid, analogous to those in the digestive tracts of mammals.

Hydrochloric acid may be manufactured by several different processes; however, over 90 % of the HCl produced in the U.S. is a byproduct of the chlorination reaction. Some examples of chlorination reactions are the production of dichloromethane, trichloroethylene, perchloroethylene, and vinyl chloride.

Chlorine and hydrochloric acid works are taken together because chlorine is often generated as an intermediate in the manufacture of hydrochloric acid. The classis mercury cell electrolysis produces both chlorine and hydrogen and these are then mixed and burnt to form hydrochloric acid gas, hydrochloric acid gas can also be formed from the use of chlorides in chemical processes, especially when a chloride and an acid react together. In all cases, the hydrochloric acid gas is absorbed in water to form liquid hydrochloric with an acid strength of 33-35 percent. Air pollution problems can also arise when chlorine or hydrochloric acid are used in other processes.

Chlorine works are defined as “works in which chlorine is made or used in any manufacturing processes.

Hydrochloric acid works are defined as “works where hydrogen chloride gas is evolved either during the preparation of liquid hydrochloric cid, or for use in any manufacturing process, or as the result of the use of chlorides in a chemical process.

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2. Sampling and Measurement of Emissions

2.1 Authority shall determine the frequency and time of sampling after discussion with works management. For chlorine works, this shall not be less than once per week and the method of testing for chlorine shall be agreed between the works management and the Authority.

2.2 For hydrochloric acid works, the frequency of sampling and testing shall normally not less than once per day, the testing being by absorption in aqueous solution and analysis for chloride ion.

3. Emission Limits and Controls

3.1 In all cases where chlorine is made or used, the concentration of chlorine shall not exceed ten (10) ppm (v/v).

3.2 In mercury cell plants, the concentration of mercury in strong hydrogen shall not exceed 0.5 mg/m^3 and in weak hydrogen (i.e., air extracted from the process vents and containing hydrogen at less than the lower explosion limit) shall not exceed two (2) mg/m^3.

3.3 The concentration of hydrochloric acid or chlorine gas in all emissions to the air shall not exceed twenty (20) mg/m^3.

3.4 Emissions to the air from all sources shall be substantially free from persistent mist or fume, and free from droplets.

3.5 The concentration of particulates in emissions to air shall not exceed one hundred fifty (150) mg/m^3.

4. Operational Controls

4.1 Treatment of Oily Swarf and Contaminated Scrap

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a. Aluminum swarf contaminated with oil-based materials shall not normally be fed to a processing furnace, but shall be treated substantially to remove the oil so as to meet the smoke limit in above paragraph. Alternatively, additional equipment, such as an afterburner, may be installed, effectively to consume smoke emissions from charging of contaminated swarf.

b. Charging of contaminated scrap, other than swarf to furnaces shall be controlled so as to minimize emissions to air.

4.2 Arrestment Plant

Because of the corrosive nature of the emissions from most secondary aluminum operations, particular emphasis shall be paid to the selection of suitable materials of construction for ducting, arrestment plant and chimneys.

4.3 Use of Chlorine

The storage, handling and use of chlorine shall be carried out with particular care to prevent emissions to atmosphere preferably to the supplier's recommendations, and to the satisfaction of the Authority. Safer alternates are recommended for use.

4.4 Use of Fluoride Fluxes

Procedures for the use of fluoride-containing fluxes shall be agreed with the Authority and additional monitoring may be needed to ensure control of gaseous and particulate fluoride emissions. Each case will be judged on its merits.

4.5 Dross Handling and Recovery

a. Drosses from the processing furnaces shall be handled and stored in such a manner as to prevent particulate emissions to atmosphere. Drosses shall be cooled in covered containers or tipped for

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cooling purposes in an enclosed building, with adequate extraction to arrestment plant if necessary in the opinion of the Authority.

b. Dross recovery operations shall be fully enclosed and extracted to suitable arrestment plant, and the remaining dross residues shall be discharged in a manner which produces no significant visible dust.

c. Where drosses and other materials contain compounds which emit noxious or offensive gases on the application of heat or contact with water, e.g. arsine or stibine they shall be stored under dry conditions in clearly marked bays or containers. Procedures for processing such materials shall be agreed with the Authority.

5. Chimneys

5.1 Chimney heights for secondary aluminum plants shall be determined by the Authority after discussion with works management.

5.2 The minimum chimney height for any rotary furnace using salt flux shall normally be thirty seven (37) meters and for other furnaces shall be three (3) meters above the roof ridge of the building to which it is attached or close by tallest building. The height may need to be increased to allow for local circumstances such as topography, nearby buildings and existing emissions.

5.3 The efflux velocity shall not be less than fifteen (15) m/s at full load operation. Where a wet method of arrestment is used, the linear velocity within the chimney shall not exceed nine (9) m/s.

5.4 For combustion process, not less than the acid dew point and in any case, not less than 80°C.

6. Environmental and Health Effects

Pollutants that are emitted by secondary aluminum production processes and include organic hazardous air pollutants (e.g., dioxins, furans, benzene, styrene, xylene, acrylonitrile, methylene chloride, naphthalene, and

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formaldehyde); inorganic hazardous air pollutants (HCl, HF, and Cl), and hazardous air pollutant metals (antimony, arsenic, lead, manganese, beryllium, cadmium, chromium, cobalt, mercury, nickel, and selenium). Emissions of these pollutants would be decreased by implementation of the proposed emission limits. Some of these pollutants are either known or probable human carcinogens when inhaled, and can cause reversible and irreversible toxic effects other than cancer following sufficient exposure. These effects include respiratory and skin irritation, effects upon the eye, various systemic effects including effects upon the liver, kidney, heart and circulatory system, neurotoxic effects, and in extreme cases, death. Following is a summary of the potential health and environmental effects associated with exposures, at some level, to emitted pollutants that would be reduced by the standard.

These metals can cause a range of effects including irritation of the respiratory tract; gastrointestinal effects; nervous system disorders (including loss of coordination and mental retardation); skin irritation; and reproductive and developmental disorders. Additionally, these metals accumulate in the environment and several of them accumulate in the human body, and may cause adverse health effects after exposure has ceased. Cadmium, for example, is a cumulative pollutant that can cause kidney effects after the cessation of exposure. Similarly, the onset of effects from beryllium exposure may be delayed by months to years. Many of the metal compounds also are known (arsenic, chromium (VI)) or probable (cadmium, nickel carbonyl, lead, and beryllium) human carcinogens.

Effects generally associated with short-term inhalation exposure to these pollutants include irritation of the eyes, skin, and respiratory tract; central nervous system effects (e.g., drowsiness, dizziness, headaches, depression, nausea, abnormal electrocardiograms); and reproductive and developmental effects. Health effects associated with long-term inhalation exposure in humans to the organic compounds which will potentially be decreased by the proposed standard may include mild symptoms such as nausea, headache, weakness, insomnia, gastrointestinal effects, and burning eyes; disorders of the blood; toxicity to the immune system; reproductive disorders in women (e.g., menstrual irregularity or increased risk of spontaneous abortion); developmental effects; and injury to the liver and kidneys.

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