Guidelines EN-G04: Chemical Fertilizer Works

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1. General Guidelines

A chemical fertilizer is defined as any inorganic material of wholly or partially synthetic origin that is added to the solid to sustain plant growth. Many artificial fertilizers contain acids, such as sulfuric acid and hydrochloric acid, which tend to increase the acidity of the soil, reduce the soil's beneficial organism population and interfere with plant growth.

Generally, healthy soil contains enough nitrogen-fixing bacteria to fix sufficient atmospheric nitrogen to supply the needs of growing plant. However, continued use of chemical fertilizer may destroy these nitrogen-fixing bacteria. Furthermore, chemical fertilizers may affect plant health. For example, citrus trees tend to yield fruits that are lower in vitamin C when treated with high nitrogen fertilizer. Fungus and bacterial disease resulting from the lack of trace elements in soil regularly dosed with chemical fertilizers is common. This lack of vital micronutrients can generally be attributed to the use of chemical fertilizers.

These notes apply to processes for the manufacture of super-phosphate, phosphoric acid, ammonium nitrate and ammonium phosphate, the granulation of compound fertilizer and the productions of complete fertilizer mixtures by melt granulation or prilling.

Texas City Disaster, Texas 1947. On 16 April 1947 at 9:15 a.m., an explosion aboard a docked ship named the Grandcamp, and subsequent fires and explosions, is referred to as the worst industrial disaster in America. A minimum of 578 people lost their lives and another 3,500 were injured as the blast shattered windows from as far away as 25 miles (40 km). Huge boulders of steel flew into the sky to rain down more than a mile from ground zero. The origin of the explosion was fire in the cargo on board the ship. Detonation of 3,200 tons of ammonium

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nitrate fertilizer aboard the Grandcamp leads to further explosions and fires. The fertilizer shipment was to aid the struggling farmers of Europe recovering from World War II. The fire was thought to have been ignited by a discarded cigarette. Although this industrial disaster was one of the largest involving ammonium nitrate many others have been reported, including a recent one in North Korea. Another industrial disaster is the Oppau explosion in Germany occurred on 12 September 1921 when a tower silo storing 4500 tons of a mixture of ammonium sulfate and ammonium nitrate fertilizer exploded at a BASF plant in Oppau, now part of Ludwigshafen, Germany, killing 500 – 600 people and injuring about 2,000 more.

2. Sampling, Measurement of Emissions and Monitoring

The tests normally carried out are total acidity and hydrogen chloride, ammonia, hydrogen sulfide, fluoride and particulates, depending on what is being processed at the time of sampling.

3. Emission Limits and Controls

a. Phosphate Rock Processing

⇒ All emissions to the air shall be substantially free from persistent mist or fume, and free from droplets.

⇒ The concentration of particulate matter in emissions to the air from phosphate rock grinding shall not exceed two hundred fifty (250) mg/m^3.

b. Super Phosphate and Phosphoric Acid Plant

⇒ The total acidity of all process gases emitted to the air shall not exceed one hundred fifty (150) mg/m^3 expressed as sulfur trioxide.

⇒ The hydrogen sulfide concentration in all process gases shall not exceed five (5) ppm v/v.

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⇒ Waste or recovered acids likely to cause the emission of odorous substances shall not be used without proper evaluation and agreement of the Authority.

c. Granulation and Prilling Plant

⇒ The concentration of particulate matter shall not exceed one hundred fifty (150) mg/m^3.

⇒ The concentration of hydrogen chloride shall not exceed two hundred (200) mg/m^3.

⇒ The concentration of ammonia (free) shall not exceed fifty (50) mg/m^3 to meet two (2) ppm ambient criterion.

⇒ The concentration of fluorides (as HF) shall not exceed two (2) mg/m^3.

⇒ VOCs should be removed/incinerated 99.99% to ensure maximum emission of twenty (20) mg/m^3.

d. Ammonium Nitrate

⇒ The concentration of free ammonia from prilling plants shall not exceed ten (10) ppm v/v.

⇒ The concentration of free ammonia from neutralizers and evaporator shall not exceed fifty (50) ppm v/v.

⇒ The concentration of particulate matter from evaporators, prilling towers and melt granulation plants shall not exceed one hundred fifty (150) mg/m^3.

⇒ The concentration of particulate matter from coolers and dryers, and from other contained emissions shall not exceed one hundred fifty (150) mg/m^3.

e. Ammonium Phosphate

⇒ The concentration of free ammonia shall not exceed ten (10) ppm v/v.

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⇒ The concentration of fluoride shall not exceed twenty (20) mg/m^3 expressed as hydrogen fluoride.

f. Operational Controls

⇒ Emissions from rock grinding, evolution of acid gases from dissolving plant and emissions from granule preparation vessels, dryers and coolers, shall be contained and ducted to a suitable treatment plant acceptable to the Authority to meet the limit values above.

⇒ Inlet and outlet gas temperatures on granulation plants shall be continuously monitored to prevent decomposition of the materials. Where ammonium nitrate is used, provision shall be made for quenching any exothermic decomposition occurring in the dryer. Measures shall also be taken to prevent the possibility of un-burnt fuel entering the dryer.

⇒ It is preferable that ammonium nitrate neutralizers should be fully enclosed with no direct vent to air, but if this is not practicable then suitable treatment equipment shall be installed to meet the limit values in above paragraphs. Total condensation evaporators are preferred to emission treatment plant.

g. Material Handling and Storage

⇒ Stocks of duty material shall be stored under cover to prevent wind-whipping. Loading to and from stockpiles shall be carried out so as to minimize airborne dust.

⇒ Storage silos for dusty materials shall be vented to air through suitable equipment to prevent dust emissions.

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⇒ All handing, transport and processing of dusty materials shall be carried out in a manner which gives rise to no significant visible emission.

⇒ The storage and handling of liquids shall be carried out in such a manner as to prevent the emission of noxious or offensive substances to the satisfaction of the Authority.

h. Chimneys

⇒ The minimum height for process gases shall be thirty seven (37) meters. Discharge heights for other emissions shall be agreed with the Authority and shall not be less than three (3) meters above roof ridge level of nearest tallest building. Emissions should take place from the minimum number of chimneys and it is good practice to combine clean, warm, dry emission with wet emissions where practicable.

⇒ To reduce the risk of mist formation, emissions containing ammonia should not be mixed with other emissions, and outlets should be spaced as far as practicable from outlets discharging acidic gases.

4. Environmental and Health Effects

Fluoride has been, and remains to this day, one of the largest environmental liabilities of the phosphate industry. The source of the problem lies in fact that raw phosphate ore contains high concentrations of fluoride. When this ore is processed into water-soluble phosphate (via the addition of sulfuric acid), the fluoride content of the ore is vaporized into the air forming highly toxic gaseous compounds (hydrogen fluoride and silicon tetrafluoride). In the past, when the industry had little), if any, pollution control, the fluoride gases were frequently emitted in large volumes into surrounding communities, causing serious environmental damage.

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In Polk County, Florida, the creation of multiple phosphate plants in the 1940s caused damage to nearly 25,000 acres of citrus groves and “mass fluoride poisoning” of cattle. It is estimated that as a result of fluoride contamination, the cattle population of Poly County dropped 30,000 heads between 1953 and 1960, and an “estimated 150,000 acres of cattle and land were abandoned.

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