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APPENDIX A

PROCESS DESCRIPTIONS FOR MAJOR USES OF NICKEL CARBONYL

Nickel carbonyl is used world-wide as an intermediate in the Mond process for extracting pure nickel from its ores [3]. In this process, crude nickel is exposed to carbon monoxide gas at controlled temperature and pressure [4]. This results in the formation of nickel carbonyl vapor which is diverted to a decomposition chamber. In this chamber, the combination of higher temperature and the existence of a "seeded" nickel compound promotes the formation of tiny nickel particles and the release of carbon monoxide. The nickel particles are allowed to "grow" until they reach the size of small pellets, termed "nickel shot" at which time they are removed from the process.

Similarly, nickel is recovered from nickel sulfide by the carbonyl process [4]. The nickel sulfide, NiS and/or Ni3S2, is "roasted" (oxidized) to produce the oxide, NiO, which is then reduced with "water gas" to form crude "sponge nickel". The "sponge nickel" is then treated with carbon monoxide to form nickel carbonyl which is decomposed with heat (as described earlier) to make nickel pellets or nickel powder.

In a process to produce methyl and ethyl acrylate monomers, nickel carbonyl, acetylene, carbon monoxide, an alcohol, and hydrogen chloride react continuously in carefully controlled ratios [42]. Although carbon monoxide gas will not enter into this reaction initially, once the reaction has started CO will react with acetylene and alcohol to produce acrylate. The carbonyl group in the acrylate ester is derived from both carbon

monoxide and nickel carbonyl, with the latter contributing about 20% of the carbonyl needed.

Nickel carbonyl has found some application in the nickel plating industry [1]. By using nickel carbonyl, nickel can be deposited on metal or other surfaces without the use of electric current. The process simply involves decomposition of nickel carbonyl vapor by heat in the presence of the target surface.

PART 2
SUBSTANCE SAFETY DATA SHEET FOR EMPLOYEES

The following guidelines are designed to help the employee understand the possible hazards and ways in which the hazard may be avoided for Nickel Carbonyl.

I. SUBSTANCE IDENTIFICIATION

A. Trade names: Nickel carbonyl, nickel tetracarbonyl
B. Scientific Names: Same as above

II. APPEARANCE AND ODOR

Pale yellow, volatile liquid with weak soot-like odor which is nearly undetectable

III. ROUTES OF EXPOSURE

Nickel carbonyl is extremely volatile and its toxicity in vapor form has been well-documented. Inhalation is the most likely route of exposure and presents the greatest hazard to the worker.

IV. HEALTH HAZARD DATA

A. Reported Carcinogenic Effects Due to Exposure

In animal studies, rats developed tumors from both long-term exposure (inhalation of 30 mg nickel carbonyl/cu m of air (4300 ppb), for 30 minutes, 3 times weekly, for 1 year) and acute exposure (single dose of 600 mg/cu m or 86,000 ppb) to nickel carbonyl vapor.

From a review of the human epidemiologic data it is not possible to confirm or deny an association of lung cancer to nickel carbonyl.

B. Other Reported Health Effects Due to Exposure

1. Acute Short-term Effects

Short-term effects can include; pulmonary edema and inflammation (interstitial pneumonitis), reduced lung capacity, heart

irregularity, liver enlargement, elevated blood and urinary glucose levels, and in severe cases, death.

2. Chronic Long-term Effects

If treatment is prompt and effective or if exposure is only slight the adverse health effects should disappear in 2-3 weeks. However, in one reported case, four patients who had appeared to have recovered were found to have radiographic evidence of fibrosis, a year after exposure.

C. Reporting Signs and Symptoms

Signs and symptoms of acute exposure to nickel carbonyl can include, shortness of breath, fatigue, nausea, and headache. These initial signs and symptoms may pass away except in the case of massive exposures. However, delayed signs and symptoms usually occur 2-10 days later and can include shortness of breath, coughing, muscular weakness, excessive sweating and substernal pain. Any worker engaged in activities which may entail the use (e.g., Mond process for nickel refining or nickel-vapor-plating) or formation (e.g., use of nickel catalysts or finely divided nickel in the presence of excess carbon monoxide) of nickel carbonyl and who experiences the aforementioned signs and symptoms should report immediately to his or her clinic or chief medical personnel. If no such facilities or personnel exist, the worker should report to the emergency room of the nearest hospital.

V. EMERGENCY FIRST AID, PRECAUTIONS FOR SAFE USE, HANDLING AND STORAGE PROCEDURES

A. Emergency First Aid

In most exposure cases, the effects are not immediately disabling and the exposed persons are able to report to the appropriate health personnel under their own power. In extreme cases where the degree of asphyxia is severe, the immediate treatment should be that for carbon monoxide

poisoning. A mixture of 95% oxygen and 5% carbon dioxide should be administered. It is of great importance to keep the patient warm but if no oxygen supply equipment is available, he should be removed into fresh air regardless of the surrounding temperature. In addition it may be necessary to apply artificial respiration. If so, the arm-lift-back pressure (Nielsen) method should be employed and not mouth-to-mouth resuscitation.

B. Precautions for Safe Use

Precautions taken in any area where nickel carbonyl is manufactured and/or used should include proper ventilation. Continuous local exhaust ventilation should provide air movement which is always from non-nickel carbonyl areas to areas containing nickel carbonyl. Where a fan is used to affect such air movement, the fan blades and throat should be made of a nonsparking material. Further, the exhaust from such exposure-risk areas should pass through a decontamination furnace before emission into the environment. These practices should be followed in the laboratory as well as in the commercial processing plant.

C. Handling and Storage Precautions

Because nickel carbonyl is extremely volatile and flammable, it should be handled only when it is contained in steel bottles. Carbon dioxide fire extinguishers should be readily accessible in all nickel carbonyl storage and handling areas.

IV. RESPIRATORS AND PROTECTIVE CLOTHING

A. Respirators

In all areas where nickel carbonyl is manufactured, stored, or used, workers should wear full facepiece supplied-air respirators. The extreme toxicity and volatility of nickel carbonyl coupled with its nearly undetectable odor emphasize the need for careful observance of this recommendation.

B. Protective Clothing

Absorption of nickel carbonyl through the skin has not been demonstrated but has been suggested. Therefore, the necessity for the use of protective gloves and impervious (e.g., rubber) clothing is uncertain. However, in view of nickel carbonyl's volatility and the major threat of exposure to its vapor, the use of protective clothing is not suggested.

☆ U.S. GOVERNMENT PRINTING OFFICE: 1977— 757-057/6704

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