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OCCUPATIONAL HEALTH AND SAFETY

GUIDELINES

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OFFICE OF ENVIRONMENTAL AFFAIRS

THE WORLD BANK

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OFFICE OF ENVIRONMENTAL AFFAIRS

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OCCUPATIONAL HEALTH AND SAFETY GUIDELINES

JUNE 1984

OCCUPATIONAL HEALTH AND SAFETY GUIDELINES

As an integral part of its appraisal and supervision function, the World Bank is required to evaluate the adequacy and effectiveness of control measures for projects involving industrial operations.

To assist the Bank's missions, the Office of Environmental Affairs has developed a series of guidelines covering industries and pollutants most frequently, or considered most likely, to be encountered in Bank lending programs.

These guidelines cover recommendations on safety and health which will help prevent and reduce accidents and occupational diseases among workers.

Application of these guidelines must be adjusted to each specific situation. Permissible health and safety measures given are considered to be achievable at reasonable costs by existing technology. Where these measures cannot be achieved, the appraisal and/or supervisory mission should fully document deviations and reasons for these deviations, be they technical, regulatory or other. Where local regulations regarding occupational health and safety differ from those presented in these guidelines, the stricter of the two should prevail.

Individual guidelines will be revised periodically by the Office of Environmental Affairs as sufficient new knowledge becomes available to warrant changes. Additional guidelines covering specific industries will be written as required.

While these guidelines were prepared primarily for use by Bank staff, their use by others is welcomed and encouraged.

Further information concerning the health and safety activities of the World Bank are available by writing to:

Office of Environmental Affairs
The World Bank
1818 H Street, N. W.
Washington, D. C. 20433
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* - Denotes both Environmental and Occupational Health and Safety Guidelines.

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OFFICE OF ENVIRONMENTAL AFFAIRS

ALUMINUM INDUSTRY

OCCUPATIONAL SAFETY AND HEALTH GUIDELINES

Introduction

1. The main safety hazards in the aluminum industry are strains from lifting and pulling, dropping objects on oneself, bruises, contusions and fractures from falling objects, burns from molten metal, chemical burns and eye injuries. Severe electrical shock accidents may also occur from the high voltage supply required in the manufacturing process.

2. Health hazards include exposure to fluorides, pitch, aluminum, dust, carbon monoxide, sulphur dioxide, heat and noise. Among the health problems that may occur from excessive exposure are skin cancer (epithelioma), in the case of coal tar pitch; necrosis of the cornea, in the case of aluminum dust; and mottling of the teeth, opacification of the bones and calcification of the articulations and ligaments, in the case of fluorides.

3. The Bureau of Labor Statistics (BLS) of the U.S. Department of Labor reported in 1975 on job-related injuries and illnesses for workers in the primary aluminum industry. The survey, based on reports from employers in the private economy, showed an incidence rate of 13.5 total injuries per 100 full-time workers in this category, against an incidence rate of 12.5 total injuries for all manufacturing workers. In the case of occupational illnesses, the incidence rate per 100 full-time primary workers was 0.2, against the incidence rate of 0.5 for all manufacturing workers.

These guidelines will cover recommendations on safety and health which will help prevent and reduce accidents and occupational diseases among employees.

Safety

4. Well constructed bins are needed for storage of large quantities of raw materials to reduce the risk of injury from falling heavy materials.

5. The crane cab must be protected, and crane drivers must be instructed in proper safety practices.

6. The transport of pitch should be mechanized as far as possible to help reduce handling accidents. For instance, heated road tankers can be used to transport liquid pitch to the works, where it is pumped automatically into heated pitch tanks.

7. All furnacemen and carbon electrode workers should be supplied with eye protection, respirators, gauntlets, aprons, armlets and spats, to protect them against burns, dust and fumes.

8. All workers involved in the Bayer process should be informed of the hazards associated with handling caustic soda. They should understand that it is corrosive and can cause serious chemical burns to the eyes and skin. Eye-wash and running water should be available in all sites at risk.

9. Personal protective equipment, such as goggles, gloves, aprons and boots, should be supplied, together with suitable barrier cream.

10. Workers employed on the Gadeau low temperature process should be supplied with special gloves and suits to protect them from hydrochloric acid fumes given off when the cells start up.

11. Respirators with chemical filters give adequate protection against pitch and fluorine fumes, but efficient dust masks are necessary for protection against carbon dust and fluoride fumes.

12. All machinery must have guards on all moving parts to protect workers from injury.

13. Electrical equipment should be grounded and checked for defective insulation. All electrical installation and equipment should be in accordance with the standards of the National Electrical Code.

14. Mechanical handling equipment must be provided for heavy loads.

15. There must be adequate passage-way for equipment, materials and workers, as well as proper signs indicating exits and doorways. Safety equipment, including fire extinguishers, should be easily accessible. Areas around exit doors and passageways must be free of obstructions.

16. All elevated platforms, walkways, stairways and ramps should be equipped with handrails, toe boards and non-slip surfaces.

17. Severe electrical shock accidents may occur in the power house and at the point where the high-voltage supply joins the series-connection network, especially as the supply is direct current. Personnel should be trained to give resuscitation to victims of electrical shock accidents.

Health

Fluorides

18. Fluoride-containing gases, fumes and dusts occur in the use of cryolite flux, and electrolytic cells emit large quantities of fluoride dust. Excessive absorption of fluorides can lead to mottling of the teeth, opacification of the bones and calcification of the articulations and

ligaments. Fluorides are retained preferentially in bone, and excessive intake may result in an osteosclerosis that is recognizable by X-ray. The first signs of changes in density appear in the lumbar spine and pelvis. Recent investigations suggest that rather severe skeletal fluorosis can exist in workers without any obvious physiological effects, detrimental effects on their general health or physical impairment.

19. It is necessary to monitor all operations where fluorides may be emitted, and the exposure levels should be kept below the following threshold limit values (TLV'S):

Fluoride (as F)	2.5 mg/m ³
Hydrogen fluoride (as F) 3 ppm	2 mg/m ³

In case of exposure to fluoride dusts, periodic urinary fluoride excretion levels have been very useful in evaluating industrial exposures.

20. Excessive exposure to fluorides must be controlled. Local exhaust ventilation must be used in operations where large quantities of fluorides can be emitted, such as Prebaked Pots and Soderberg Pots. Personal protective equipment should be provided and this should include dust masks or gas masks with an appropriate canister or supplied respirator, goggles, or face masks, gloves, gauntlets, aprons and boots. Personal hygiene should be encouraged, with showering following each shift and before change to street clothes.

Pitch

21. Exposure to pitch occurs during the handling of the material and in electrode manufacturing. It is, therefore, advisable for all men working with it to be on a rotation system of one week on, and two weeks off this job. Regular skin examinations are recommended for every six months to detect epithelioma, erythema or dermatitis. The use of an alcinat-base barrier cream can provide some skin protection. Workers exposed to pitch fumes in electrode manufacturing may develop erythema, and exposure induces photosensitization with increased irritation. Cases of epithelioma have also occurred among carbon electrode workers. Considerable quantities of carbon and pitch dust occur during electrode manufacturing and carbonelectrode workers may develop a simple pneumoconiosis with focal emphysema; this may be complicated by the development of massive fibrotic lesions.

22. It is necessary to monitor the air for coal tar pitch volatiles, now referred to as particulate polycyclic aromatic hydrocarbons (PPAH), as benzene solubles, and their TLV should not go above 0.2 mg/m³.

23. Local exhaust ventilation is needed to help protect workers from excessive levels of pitch dust and fumes. Workers also should be provided with personal protective equipment, including dust masks, gloves, gauntlets, aprons, armlets and spats.

Burns

24. Workers can be exposed to severe burns from molten metal and from various chemicals such as caustic soda and hydrochloric acid. Skin and eye accidents involving molten metal and hydrochloric acid fumes occur in the electrolytic reduction operations. In the Bayer process, the use of caustic soda may result in chemical burns to the skin and eyes. All workers should be well informed of the hazards involved in these operations. Emergency eye-wash and showers must be provided in all sites at risk involving caustic soda and hydrochloric acid fumes. Personal protective equipment should include gloves, goggles or face shields, aprons and boots. Suitable barrier creams should also be supplied. In some operations, protective clothing must be provided.

25. It is necessary to monitor for hydrochloric acid fumes and the exposure should not be allowed to go above a TLV of 5 ppm (7 mg/m³).

Other Air Contaminants

26. Carbon monoxide is a colorless and odorless gas resulting from incomplete combustion, which may be given off at the Prebaked Pot and Soderberg Pot operations. Symptoms of poisoning are headache, fatigue, poor judgment, shortness of breath, weakness and dizziness, leading to nausea, vomiting and, at high concentrations, unconsciousness.

27. Sulphur dioxide is a colorless gas which may also occur at the Prebaked Pot and Soderberg Pot operations. It is particularly irritating to the mucous membranes of the upper respiratory tract. Acute overexposure may cause chemical bronchopneumonia. Chronic exposure may cause nasopharyngitis, fatigue, altered sense of smell and chronic bronchitis symptoms such as dyspnea on exertion, cough and increased mucous excretion.

28. Exposure to aluminum dust can occur during the electrolytic reduction process. Particles of aluminum deposited in the eye may cause necrosis of the cornea. The systemic effects of aluminum on the human body caused by the inhalation of its dust and fumes are not known with certainty at this time. Present data suggests that pneumoconiosis might occur. In the majority of cases investigated, however, it was found that exposure was not to aluminum alone, but to a mixture of aluminum, silica fumes, iron dusts and other materials.

29. Aluminum dusts can also be a fire and explosion hazard and wet methods should be used for dust collection.

30. It is necessary to monitor these operations where these contaminants occur and exposures should not be allowed to go above the following threshold limit values (TLV's):

Aluminum metal and oxide		15 mg/m ³
Carbon monoxide	50 ppm	(55 mg/m ³)
Sulphur dioxide	5 ppm	(13 mg/m ³)

Excessive levels of aluminum, carbon monoxide and sulphur dioxide should be controlled by local exhaust ventilation.

Heat Stress

31. Workers can be exposed to excessive heat, particularly at the electrolytic furnaces where temperatures in the region of 38° to 43° C are common. Early symptoms of heat stress are weakness, extreme fatigue, dizziness, nausea, headache and thirst. More serious symptoms are leg, arm and stomach muscle spasms, irregular or increased heart beat, extreme thirst and fainting.

32. General ventilation must be provided where high temperature is a problem. Cool drinking water and salt tablets should be available to employees.

Noise

33. Excessive noise can cause permanent hearing loss. Loud background noise (90 dBA) dulls human senses, including visual acuity and increases accident rates. If the noise level around the machinery is higher than 90 decibels, those persons working on or near the equipment should be supplied with ear muffs. In situations where a worker must stay permanently near the equipment, a noise-insulated room should be provided from which the worker can watch the piece of equipment through a window.

34. Excessive noise can be a major hazard in the aluminum industry. High noise levels of 100 dBA are found in the use of pneumatic crust breakers in the furnace rooms and in the grinding of coke in ball mills. Noise levels can be reduced by the separation and isolation of noisy operations, as well as impact reduction and vibration dampening by lamination or lining with acoustic materials. Mufflers on compressed air equipment exhausts and proper lubrication and maintenance of machinery will also reduce noise levels. Consideration of noise producing characteristics should be given before purchasing new equipment.

Sanitary Facilities and Requirements

35. Good sanitary and washing facilities, including shower accommodations, must be provided. Separate lockers for work and street clothes should be provided. Employees should be encouraged to wash up before eating. A separate lunchroom should be provided outside the work area.

Medical Examination

36. Pre-employment and periodic medical examinations of all workers are recommended. In the case of workers exposed to pitch, skin examinations are also recommended every six months (see para. 21).

Training and Education

37. The education and training of employees in good safety practices is the responsibility of management. Employees should be instructed in safety and good working practices in all phases of their work. This should include regular training programs in the proper use of all equipment and machinery, safe lifting practices, location and handling of fire extinguishers, first aid procedures, the use of personal protective equipment, and the long range hazards associated with contacting the chemicals discussed in this guideline.

Record Keeping

38. Management is required to keep records of all accidents and illnesses which have involved the employees in the plant. This information should be made available to the World Bank. An evaluation of injury and health data will assist the Bank to evaluate the effectiveness of its occupational safety and health program.

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OFFICE OF ENVIRONMENTAL AFFAIRS

ASBESTOS - MINING AND MILLING

OCCUPATIONAL SAFETY AND HEALTH GUIDELINES

Introduction

1. The main safety hazards associated with the mining and milling of asbestos are covered in mining and other manufacturing industry. The emphasis of this guideline will be on the health hazards associated with the mining and milling of asbestos.
2. Exposure to asbestos fibers is associated with a number of diseases, including asbestosis (a non-malignant scarring of the lungs), lung cancer, cancers of the stomach, colon and rectum, and mesothelioma (a cancer of the chest cavity) and abdominal cavity (see Reference 7). Symptoms often do not appear until twenty to thirty years after initial exposure. Once established, asbestos disease may progress even after exposure ends.
3. The release of asbestos fibers to the environment occurs during mining and milling of asbestos minerals and during the manufacture, distribution, use and disposal of asbestos-containing products.

MINING PROCESS AND EMISSIONS

4. Most asbestos ore is mined in surface operations. Each operating mine is associated with a mill that processes the ore.
 - a. Open cast mining, involves removal of the ore by earth-moving equipment from shallow deposits. There will be emissions of asbestos from overburden dumps and exposed ores through weathering and in concentrated amounts from blasting, drilling, overburden and ore removal.
 - b. Underground mining of asbestos entails following the veins of ore with shafts, galleries and drifts using blasting and earth moving equipment. As there is no overburden removal and ore veins are not exposed to weathering, emissions are lower than for surface mining techniques. There will be significant emissions from surface ore transfer and hand-separation (cobbing) of ore.