Heat Treat Salt Safety Guide

Eye Wash Stations and Safety Showers Should Be Available

Provisions Relating to Premises

Location and Isolation of Salt Baths

Salt baths shall preferably be located at ground-floor level. If on an upper level, a bath should be placed on a suitable strengthened concrete floor. Where practicable, the section containing the salt baths shall be separated from other sections of the workplace by means of fire-resisting walls, ceilings, and doors, and shall be reserved exclusively for the heat treatment process.

Accidental Entry of Water

Provision shall be made to ensure that water cannot accidently enter a salt bath from water pipes, steam pipes, leaky roofs, or condensation from overhead or from other sources. Fire sprinkler systems shall not be fitted in heat treatment areas containing salt baths.

Flooring

The floor area under and around every salt bath shall be constructed of concrete or suitable non-combustible material and shall be kept free of any obstruction likely to cause tripping or slipping hazards.

Adequate Working Space

In rooms where one or more salt baths are situated, the baths shall be so placed as to provide adequate working space in the vicinity of each bath for every person working in that part of the premises.

Nitrate Salt Spillages

The surface of the floor shall be kept clean and any spillages or splashes of molten nitrate salts shall, when cold, be removed promptly by sweeping or other means.

Quench Baths

Every quench bath which forms part of a heat treatment process shall, where practicable, be located at a safe working distance (at least 24 inches) from any salt bath. The level of the top of every quench bath shall be lower than that of the nearest salt bath to reduce the risks of splashes from the quench bath reaching the molten salts. If either of the above statements cannot be met, the provision of a suitable relocatable baffle or screen to eliminate the entry of quench bath water splashes into a nearby molten salt bath will be mandatory. Flexible hoses shall not be used for filling or replenishing water in quench baths. Provision shall be made for the safe discharge of quench bath water to a suitable drain. If water is contaminated with cyanide salts, it must be rendered harmless by chemical treatment before being discharged.

Identification

Every bath shall be clearly and indelibly marked on the outside or above it with a sign indicating whether nitrate or cyanide salts are present within.

Temperature Control and Alarm Devices

The following four provisions should be taken as applying to all types of salt baths:

1. Every salt bath shall be equipped with at least one efficient device by which the temperature of the molten salt is kept within safe working limits. Any such control shall operate as a thermostat or otherwise serve to cut off the heat source automatically before the upper limit of the safe working temperature is reached. All such temperature control devices shall be constructed so that they fail to safety. It is recommended; however, that the practice of installing two independent systems of temperature control in each bath should be followed; one operating as an overriding cut-out if the main control system fails. The overriding cut-out safety device should be adjustable if the bath is to be operated at more than one specified temperature and the setting of the device should always be closely related to the particular temperature at which heat treatment is to be carried out.

2. Where the heat control circuit fails or is interrupted, it shall remain off until the control is reset by hand. For gas or oil heated baths, a manual reset valve shall be provided.

3. All heat control devices shall be tested regularly to ensure that the cut-out operates effectively in the event of an emergency; such tests should be at monthly intervals for baths in regular use. The results of the tests shall be entered in a register which shall contain the following details: date of test, description of device tested, remarks and signature of the person conducting the test.

4. Every salt bath shall be equipped with an audible and visual alarm device capable of giving a clear warning in the event of the temperature of the salt exceeding a safe predetermined level.

Only nitrate baths present an explosion hazard with respect to overheating and hence the above provisions must be applied most rigorously in this case. Overheating of other baths may result in bath failure, the production of dangerous fumes, undesirable case depths in case-hardening work, and generally poor economy of operation.

Additional Electric Heating Safeguards

Where the heating is by medium of electric current, the following additional safeguards shall apply:

1. Each individual heating unit shall be provided with automatic excess current protection which shall operate at the smallest practicable differential. Circuit breakers are preferable to fuses as they can be selected to provide closer protection tolerance.

2. Electrode heating elements shall be provided with guards to protect them against accidental short circuits and the guards shall be designed so as to interfere as little as possible with the circulation and even heating of the salt.

3. Immersion heaters shall be capable of being easily removed for inspection and cleaning. Each immersion heater shall be fitted with a guard to prevent mechanical damage to it. All electric heaters shall be capable of being controlled to generate to generate heat at a reduced rate during the melting period of the salts.

4. Every electrically heated bath shall be provided with an earth leakage indicator and earth leakage trip mechanism shall be installed so as to cut off the electrical supply when any leakage exceeds a predetermined value.

5. The following measurements shall be taken regularly and at least once a month while the heaters are hot and the results of the test shall be entered in a register and signed by the person conducting the examination:
    (a) The insulation resistance of each unit of the heaters.
    (b) The ohmic resistance of each unit of the heaters.

General Precautions

Instruction and Supervision of Workers

Every person required to work at or in the vicinity of any salt bath shall be properly instructed as to the hazards connected with the process and the precautions to be taken. Adequate supervision by a competent person shall be maintained during all stages of the heat treatment process.

Fire Hazards to be Notified

The occupier of every factory in which salt baths are installed shall notify the local Fire Authorities of their existence and location. A precautionary warning notice – "Chemical Bath – Introduce No Water or Other Foreign Matter – Explosion Danger" should be displayed in prominent locations inside and outside the bath area to prevent mistakes.

Fire Fighting Equipment

A sufficient supply of dry sand shall be stored in suitable containers near salt baths to be used for fire fighting purposes. No vaporizing liquid, such as carbon tetrachloride, water, foam, or aqueous extinguishing agent, shall be used for fighting fires near molten salt baths. The area containing salt baths shall not be equipped with a water sprinkling system for firefighting. For fires at nitrate salt baths, a sufficient number of carbon dioxide or approved dry powder fire extinguishers shall be provided in the vicinity of the bath for firefighting purposes.

Operating Rules

General Rules

1) **Explosive Generation of Steam** - - Water must not be allowed to come in contact with molten salt of any kind. An exception to this may occur in the martempering or austempering of steel in which small quantities (approx. 1%) or water may be added to hasten the cooling process. Vigorous agitation of the salt at the point of addition must be maintained to reduce splattering and the temperature of the molten salt bath would normally be low.

2) **Pre-Heating** - - No article which is moist shall be immersed in a salt bath until the article has been thoroughly dried. This applies to both the work itself and to work handling devices, such as tongs and baskets. It is important to pre-heat work in a furnace before salt bath treatment since this ensures both that the articles are dry and that the work reaches the salt temperature more rapidly.

3) **Care of Hollow Workpieces** - - Work-containers or tools to be used in a salt bath heat treatment process shall be made of solid materials. No container or tool made of tubular or hollow parts likely to trap air or water shall be inserted into molten salt. Work shall be immersed in the bath in such a manner that entrapped air can escape without causing danger.

4) **Precautions in Heating Up from Cold** - - The person in charge of any salt bath shall, throughout the whole of the preliminary heating stages, ensure that the heat is applied gradually so that over-heating of any part of the bath does not occur. In the event of overheating, which is likely to cause damage, a thorough inspection of the bath shall be made as soon as possible thereafter.

5) **Combustible Material Prohibited** - - Carbonaceous or other combustible materials, in particular wooden duckboards, shall not be permitted in the vicinity of any salt bath while it is in operation.

6) **Condition of Salts to be Added** - - When it becomes necessary to replenish the supply of salt while the bath is in a "heated state", the salts to be added shall be thoroughly dry and free of deleterious impurities.

7) **Salt Residues to be Dried Out Before Re-melting** - - Salt impregnating the ceramic lining in certain furnaces will pick up moisture on standing. If such a furnace has stood for more than 24 hours, the lining should be dried out since moisture in the lining may cause a salt spurt. Drying out can be conveniently done with a small electric heater until the brick lining is thoroughly warmed.

8) **Explosion Hazard from Molten Nitrate-Cyanide Mixtures** - - No cyanide or compound containing cyanide shall be added to a nitrate salt bath (or vice versa), either as bulk salt or as the adhering crust on work pieces removed from a previous salt bath. To avoid unnecessary cooling of work, removal of cyanide or nitrate salts can be carried out by rinsing in a neutral chloride salt bath maintained near the appropriate temperature before transference to the next bath in the salt bath cycle.

Maintenance of Salt Baths

Sludging

Salt baths that are in continuous use shall be desludged frequently and baths that are only used intermittently shall be desludged at regular intervals as required. Perforated metal scoops or other suitable appliances should be used.

Examination

Every salt bath which is used regularly during each working week shall be emptied, cleaned, and thoroughly examined at least once in every period of six months; provided, however, that in the case of internally heated baths using immersion heaters, the examination need only be carried out at twelve-month intervals. The examination shall be recorded along with any faults found, maintenance work done and the name of the person carrying out the inspection.

Salt Removal in Solid State

Special care shall be taken when removing used salt which has solidified in the bath to ensure that no damage is done to any part of the receptacle, heating appliances or to any other part of the bath.

Salt Removal in Molten State

If the salt mixture is in a molten state when the bath is being emptied, the following additional precautions shall be taken:

1) All emptying devices, receptacles, and containers used for this purpose shall be made of suitable material and be of adequate strength to retain the molten salt.

2) Appliances which are used for emptying the bath shall be thoroughly cleaned and dried before use. All emptying devices shall be used at a safe distance from any person working in the vicinity of the bath.

3) No combustible materials shall be allowed to remain in the immediate vicinity while a molten mixture is being removed from the salt bath.

4) All persons engaged in the emptying shall wear suitable protective clothing while such operations continue and shall remain at a safe distance from the bath when handling molten salts.

Disposal of Used Salts

Disposal of Used Nitrate Salts

1) Nitrate salts shall be disposed of in a safe manner after being used. Burial of waste salt in a refuse dump may be contemplated but, the area should be chosen only after consultation with the relevant local body and always with regard for the provisions below.

2) Used nitrate salts shall not at any stage of their disposal, be allowed to come in contact with carbonaceous or other materials under conditions where fire or an explosion may result.

Disposal of Used Cyanide Salts

1) Cyanide wastes in the form of used salts from baths or contaminated quench water must be chemically decomposed before they are disposed.

2) Decomposition is accomplished by treating the cyanide salt in aqueous solution with an oxidizing agent, e.g., sodium hypochlorite or calcium hypochlorite (bleaching powder).

3) Discharge of untreated cyanide waste must be strictly avoided since, besides the obvious danger of first-degree pollution, there is also a considerable hazard in industrial areas that a nearby factory may discharge acidic waste at the same time, with the possible resulting formation of lethal hydrogen cyanide gas in sewers and drains.

4) Industrial waste treatment firms are the preferred agents for disposal.

5) Liaison with the relevant local authorities is strongly recommended with respect to the whole question of cyanide waste disposal.

Protective Clothing and Equipment

Provision to be Made

The occupier of every factory in which a salt bath is operated shall provide each person working at the process with suitable protective clothing. Such clothing shall include an apron and a pair of gloves or gauntlets capable of covering hands and forearms. General clothing should not be excessively bulky or such as to restrict ease of work-handling. Aluminized or heavy-duty leather are suitable materials for aprons and gloves. A suitable face visor shall be provided for each worker engaged in the process; a visor of tinted glass may be preferred to shield eyes against bright light from very hot salt of metal. Carbonaceous or hygroscopic materials, such as asbestos millboard, shall not be used as portable heat shields.

Laundry and Cleaning

The employer shall make suitable provision for washing and cleaning of overalls and other protective clothing if such equipment becomes contaminated with salt splashes. In particular, nitrate salts should be washed out of clothing with water at regular intervals (not dry-cleaned), since if material becomes impregnated with the salts, any subsequent molten splashes which cause clothing to ignite will be made more serious by the oxidizing nature of the nitrate already present.