Control and Monitoring of Liquid Effluent

1. Introduction

Efficient and viable industries are an essential element of sustainable development, but unless there are adequate controls mechanisms for treatment of process water and any liquid by-products produced there can be potentially lethal threats to the environment and human health.

2. Sources of Liquid Waste

In the lead industry water is in great demand in every sector. For example; at the mine during primary production it is a key feature of many process such as milling and grinding, and flotation; secondary smelters demand water for battery breaking and cooling towers; battery manufacturers require ionized water to prepare the battery electrolyte. In most countries, surface water from rainfall or snow presents an additional effluent burden as there is a likelihood that the precipitation will become contaminated when it falls onto the roofs of buildings, walkways, roads and process areas of the lead plant. Additional problems are prevalent in those parts of the world that experience annual monsoon rains as water can potentially flood into the process areas and become contaminated as it flows through the operating areas. A lead industry's housekeeping and hygiene program will also generate liquid effluent at the vehicle wheel wash, work-wear laundry, employees' showers and rest rooms.

3. Liquid Waste Properties

Liquid waste that is not managed properly will normally have the following properties, whether the effluent is from the mining operations, such as tailing ponds or battery breakers, it will be acidic, extremely corrosive and invariably toxic due to the presence of heavy metals which will also render the effluent bio-toxic and an ecological hazard to plants and wildlife.

4. Causes of Potential Risks

So what are the causes of potential risks:

- There is the shear quantity of water required in mining, smelting and refining operations and the speciation of the liquid effluent.
- Lead is soluble in both acid and alkaline solutions.
- Heavy toxic metals tend to be dissolved in the liquid effluent and fine dust particles that are suspended in the liquid are difficult to separate.
- Inadequate collection of both process and surface water together with poor unsealed storage lagoons will allow the effluent to drain and percolate into surrounding soil.
- Tailings ponds can be breached if they are not managed properly and inspected regularly for signs of weakness in the dam structure.
- Inadequate chemical treatment and neutralization prior to discharge will result in unsatisfactory disposal.

5. Analysis of Waste Water

To determine the appropriate effluent treatment required and to monitor performance it is essential to test surface and process water prior to any discharge from a lead plant:

- After collection
- During treatment
- Prior to final discharge

Whilst some tests might be site specific, depending on the industry, it is essential to analyze for:

- Suspended lead
- Dissolved lead
- The acidity/alkalinity, i.e. the ph value
- Heavy metals such as antinomy, copper, zinc, arsenic, cadmium and mercury
- Test for oil, grease and dissolved salts, particularly if the process requires the use of caustic soda or other reagents that produce soluble heavy metal salts.

6. Control of Liquid Waste

These guidelines provide the basis for the control of liquid waste:

- Ensure that there are adequate collection and containment facilities on site for both process and surface water.
- For those plants at risk of flooding during monsoon rains ensure that the water treatment plant is not only above ground, but also above the level of likely flooding. In addition ensure that there are channels and barriers around the perimeter of the plant to direct the floodwaters away from the process areas.
- Segregate the process and surface effluent to ensure that relatively uncont aminated surface water does not have to pass unnecessarily through the entire water treatment plant prior to discharge.
- Allow time for the small and fine particles suspended in the effluent to settle in a lagoon and test the wastewater to determine the appropriate treatment.
- Every effort should be made to either utilize or re-circulate the treated water and thereby reduce the amount of wastewater discharged to the environment and the quantity of fresh water required for topping up the process water requirements.

7. Collection and Containment

In order to benefit from the potential cost savings of segregating process water from surface water, it is essential that the plant working areas are kept as clean and lead free as possible.

It is far easier to remove one or two contaminants at a time than to treat a "cocktail" of liquid effluent. It is therefore desirable to design the wastewater collection system so that the different waste streams are segregated and treated separately.

Contaminated surface water and process effluent should always drain to sealed lagoons, concrete bunkers or storage tanks to allow solids to settle prior to any treatment. An exception might be a lagoon adjacent to a battery breaker, where it might be preferable to agitate the effluent to maintain the lead oxides and sulfates in suspension so that, when the water is returned to the gravity separation stage of the process, they can be removed in the settlement tanks of the oxide separation conveyors.

Two or three smaller lagoons are usually easier to manage than one large lagoon. For example with three lagoons, they could be managed so that one would be filling with waste water, a second would be settling prior to treatment or being filtered and chemically treated and the third would either be discharging or being used to top up the process water requirements.

8. Segregate, Separate or Filter

Settlement and/or filtration are usually all that is required for most of the rainwater and the water collected from a vehicle wheel wash prior to re-circulation or discharge. The mining flotation process water is returned to the plant after the metal concentrates are filtered and the tailings settled in a pond.

Much of the waste process water, however, will require a period to allow suspended solids to separate and also chemical treatment prior to discharge to the environment.

With recycling in mind consideration should be given to utilizing any waste battery acid. Filtered battery acid can be recovered and following chemical treatment reused in new batteries. Neutralization of the battery acid with, for example ammonia or magnesium salts can produce valuable crop fertilizers. Neutralization with calcium salts will produce "gypsum", which can be used in the manufacture of cement and plaster board. Neutralization with sodium salts will produce an inert filler often used by the washing powder industry. Filtered recovered battery acid can also be used in the water treatment pant during some of the specific chemical treatment processes to neutralize the effluent after precipitation of heavy metals such as cadmium at pH 11.

9. Utilize or Recycle

Water is essential to many of the processes in the lead industries and as clean water becomes an increasingly expensive commodity it makes economic sense wherever possible to collect rainwater from surface water drains and top up process water requirements "free of charge". The sound management of surface water will also ensure that in the unlikely event of a major chemical or toxic metal spillage that the surface water drainage system will contain any environmentally unfriendly spill on the site. Accordingly a closed loop process water system provides ideal environmental control and maximizes recycling.

Secondary lead processing plants should collect and store the battery electrolyte during the initial breaking stage prior to either neutralization or reprocessing. Secondary metal processing plants should also be aware that modern mechanical battery breaking machines will generate an acid aerosol, which without adequate hooding, encapsulation or ventilation represents an additional occupational risk often resulting in occupational exposure problems.

10. Treat and Dispose

Once the segregated wastewater has been collected:

- Remove the suspended solids by filtration or settlement.
- Chemically treat the wastewater to remove any heavy metal contamination.
- Neutralize to between ph 7 and 9.
- Any wastewater that cannot be recycled can be allowed to evaporate - a most economical method of disposal in a warm or hot climate.
- Wastewater must be sampled and analyzed prior to discharge to ensure that the treatment process has produced an effluent that complies with all the local and national standards for discharge of industrial effluent to the environ ment.
- Choose discharge points and the rates of discharge to any fresh water river with care so that large volumes of oxygen deficient water are not released into the aquatic environment to the detriment of native aquatic life and the river's eco system.

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