METRO

WASTEWATER MANAGEMENT DEPARTMENT

GUIDELINES FOR THE MANAGEMENT OF

METAL FINISHING INDUSTRY EFFLUENT

DEVELOPED BY THE DURBAN CHAMBER OF COMMERCE

BYLAWS WO RKING GROUP

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GUIDELINES FOR THE MANAGEMENT OF METAL FINISHING INDUSTRY EFFLUENT DEVELOPED BY THE DURBAN CHAMBER OF COMMERCE BYLAWS WORKING GROUP

The purpose of this document is to provide a guideline for the management of metal finishing industry effluent. This is a guideline document only and it is acknowledged that other, equally acceptable, methods and processes are available which will also maintain an acceptable discharge and result in compliance with effluent standards under all conditions of discharge.

The guideline document does, however, represent a guide to practical treatment processes, process control methodology and engineering design. It also sets out how the Department will exercise controls to ensure compliance with effluent quality limits. Adoption of the recommendations given in this guideline document will provide for both industry's compliance with effluent standards and the Department's statutory control function, without this latter entailing excessive costs. The adoption of this guideline document and the implementation of the statutory control function by the Metro Wastewater Management Department will come into effect on the 1st October 1999.

The guidelines consider the following aspects:-

A. Correct treatment process chemistry

B. Correct process control

C. Correct engineering design

D. Metro requirements for effluent compliance and monitoring

E. Methods of sludge handling storage and disposal

A. Proposed Treatment Process and Chemistry Guidelines for Six Classes of Metal Finishing Effluents

The recommended treatment process for six classes of metal finishing effluents is set out below.

Class 1: Treatment of Effluents from Powder Coating and Anodising Operations

This effluent generally contains zinc, (from the zinc phosphate dip), Chrome (from the chrome passivation) and iron or aluminium which are the base metal coated.

Note: The phosphate dip can either be of zinc or iron phosphate. The passivation dip can be either high or low in chromium. Most factories use the zinc and high chrome options because these give better corrosion protection. Some, for cost reasons and indoor applications, use the iron phosphate and low chrome passivation.

Treatment Process Recommended

The effluent is either acid or caustic from the metal cleaning operation. The treatment steps recommended for batch operations are:-

(a) pH adjust to 9 to 9,5

(b) Batch settling

(c) Discharge of supernatant to sewer

(d) Discharge of sludge to waste disposal site

Note: 1. The optimum pH for zinc precipitation is 9,0 to 9,5. High or low pH values will lead to zinc in the effluent.

2. The treatment process is complicated if aluminium is also present in the effluent since the optimum pH for aluminium is 6,5 to 7,5. Due to the greater toxicity of zinc, the process should rather be optimised for zinc removal.

Class 2: Treatment of Effluent Using Cyanide but not Containing Chrome

Cyanide is used in the plating of zinc, cadmium, gold, silver brass and copper.

Treatment Process Recommended

The cyanide must be destroyed at high pH in order to prevent the formation of HCN. The process recommended is:-

(a) pH adjust to about 9.

(b) Oxidise cyanide to destruction using chlorine, HTH or sodium hypochlorite. This step can be done on individual or combined streams.

(c) The heavy metals are also precipitated at this high pH.

(d) Batch settling.

(e) Discharge supernatant to sewer

(f) Discharge sludge to waste disposal site

Class 3: The Treatment of Effluent Containing Cyanide and Chrome

Treatment Process Recommended

The accepted process is to separate, in-house, the cyanide and chrome streams and to treat them separately. Separate treatment is undertaken in order to prevent the formation of HCN gas which could be generated from a mixed effluent if the pH of the mixed effluent tank becomes acidic. The recommended treatment process is therefore:-

(a) Separate in-house the cyanide and chrome effluent.

(b) Oxidise cyanide stream at high pH.

(c) Reduce chrome stream at either high or low pH depending on the reducing agent used.

(d) Combine the streams and then adjust pH about 9 to 9,5 to precipitate out metals.

(e) Batch Settle.

(f) Discharge supernatant to sewer

(g) Discharge sludge to waste disposal site

Class 4: Treatment of Effluents Not Containing Cyanide But Including Chrome

Treatment Process Recommended

The process requires reduction of chrome followed by pH adjustment for precipitation of metals. The process steps are:-

(a) Adjust pH

(b) Add reducing agent (e.g. Sodium Hydro Sulphite)

(c) Adjust pH to 9 to 9.5

(d) Batch Settle

(e) Discharge supernatant to sewer

(f) Discharge sludge to waste disposal site

Class 5: The Treatment of Effluent Not Containing Cyanide, Chrome, Lead or Tin

Metals include aluminium, nickel, copper, and zinc.

1. The effluent can also include a small quantity of chrome from the passivation of aluminium. If this is the case the Chrome (6^+) must first be reduced to Chrome (3^+). The chrome, will not appear in the effluent provided that the final pH is about 9.

2. Zinc and copper are normally plated from cyanide solutions but are, however, found in effluent from radiator refurbishing factories resulting from the cleaning and welding of radiators.

Treatment Process Recommended:-

(a) For aluminium: pH to 6,5 to 7,5

(b) For copper, zinc and nickel: pH to 9 to 9,5

(c) Batch Settle

(d) Discharge supernatent to sewer

(e) Discharge sludge to waste disposal site

Class 6: Effluent Containing Lead and Tin

Tin and lead dissolve at both high and low pH levels. Tin and lead can be precipitated using sulphides and with lime provided the pH is correct.

Treatment Process Recommended

(a) The optimum pH must first be determined in the laboratory.

(b) Adjust pH to optimum pH

(c) Add sulphides and lime

(d) Batch settle

(e) Discharge supernatent to sewer

(f) Discharge sludge to waste disposal system

B. CORRECT EFFLUENT TREATMENT PROCESS CONTROL

B.1 pH

pH Paper is suitable for small concerns provided that the correct range is selected for the particular application. A pH meter is more suited to a larger company which is capable of pH meter calibration and maintenance.

B.2 Redox

Correct Oxidation and reduction potentials are required for cyanide oxidation and chrome reduction.

The Redox potential can be measured using a good quality pH meter. Alternatively test kits are available for measuring cyanide and Chrome (6^+).

C. ENGINEERING DESIGN FOR CONTROLLED EFFLUENT DISCHARGE

C.1 Type of Reactor

C.1.1. Batch Reactors

Because of the ease of the operation and lower cost, a batch rather than a flow through reactor is recommended for most applications. Batch tanks are suitable for all installations less than 20 kℓ/day.

Batch tank systems should be provided with 3 tanks each with a minimum of 1 day capacity as follows:-

Tank 1	=	Filling	:	Day 1
Tank 2	=	React and settle	:	Day 2
Tank 3	=	Drain to sewer	:	Day 3

The batch tank draining to sewer must be discharged during working day hours with supervision to ensure compliance and allow audit checks by Council.

C.1.2 Flow Through Reactor

For more than 20 kℓ/day the tank size could be unwieldy for good batch control. Flow through should therefore be considered for effluent volumes greater than 20 kℓ/day.

The tank must be accessible for chemical addition and process control monitoring.

The following is recommended :-

(a) Automatic pH control

(b) The tank must be well mixed.

(c) For a continuous settler provide approximately 0,5 m/hr upflow rate.

(d) Pulsed sludge withdrawal.

C.2 Mixing

Adequate mixing is vital for good process operations. Two options are suitable:-

C.2.1 Air Mixing

Air mixing is adequate provided that the tank is fitted with diffusers or multiple orifices and not a single sparger pipe.

C.2.2 Mechanical Mixing

The best mixing is achieved with a propeller type mixer.

C.3 Sludge Separation

C.3.1 Settling Time

For a batch reactor provide approximately 8 hours settling time.
For a continuous settler provide approximately 0,5 m/h upflow rate.

C.3.2 Clear effluent Draw-off Point From Batch Settling Tank.

Clear liquid draw-off from a batch settler should be through an 'L' shaped pipe where the top of the draw-off is about 500 mm from the tank bottom. The tank must be desludged when the level of the sludge reaches about 300 mm from the tank bottom. A sample valve must be set at 300 mm to provide a check on sludge level.

C.3.3 Clear Effluent Draw-off Rate

Effluent to sewer draw off should be through an orifice or pulse valve in order to provide drainage during working hours and over 8 hours to provide for supervision and audit checks by Council.

D. METRO REQUIREMENTS FOR EFFLUENT COMPLIANCE AND MONITORING

The responsibility to control the treatment process such that it complies with the permitted quality limits and the responsibility to monitor the effluent such that the effluent quality is known must reside with the factory. The Metro's role is to undertake spot checks to determine compliance. All analysis to be undertaken on digested samples

This Guideline document prescribes the minimum standard to be applied to all metal finishing industries in the Metro, such that ad-hoc sampling by Metro on a random basis of a slow, even, discharge of effluent e.g over an eight hour period can be made . There will be a period allowed for the implementation of this requirement.

D.1 Metro to Sample as follows:-

D.1.1 All factories once per week, where industries are seen to be complying this monitoring is to be relaxed to say twice per month.

The tariff rate for regulatory monitoring will apply.

D.1.2 For those industries that do not comply adequately, it will be necessary for Metro to carry out more frequent monitoring which will be charged for on a cost recovery basis. The full cost of which will come into effect on the 1st October 2000 .

D.2 Cost Recovery

Additional monitoring at a cost of R105-00 per sample will be phased in as follows:

1/10/99 to 31/3/2000	No additional cost
1/4/2000 to 30/9/2000	50% of cost
1/10/2000 onwards	Full cost

The above costs will be subject to annual tariff changes.

D.3 Limits for Effluent Discharge

Until such time that definite direction is provided by Department of Water Affairs and Forestry in terms of any addendum or any revision to the 1997 Sludge Disposal Guidelines, the current agreement (as put in place at the formation of the Working Group) will be continued viz:-

D.3.1 the metal limits as per the attached Schedule A continue to be relaxed (through the mechanism of clause 4/6 of the Sewage Disposal Bylaws) to those pertaining via the previous Bylaws of each of the erstwhile Local Authorities to existing permitted dischargers, as per Table 1.

D.3.2 in any area of the Metro where either there were no Bylaws or the Bylaws had no stated limits for metals, then the limits as Schedule A will continue to apply.

D.3.3 permits for metal plating industries wishing to set up a new business in the Metro will be subject to the metal limits as Schedule A.

E. SLUDGE HANDLING STORAGE AND ACCEPTABLE DISPOSAL

The sludge can either be dewatered on site using a filter press or disposed of as liquid sludge to tanker for off-site treatment.

E.1 Prevention of sludge discharge to sewer.

E.1.1 Clear effluent draw-off design is to be as per sketch attached.

E.1.2 Clear effluent is to be discharged through a filter to Council sewer.

E.2 Sludge Storage

Waste sludges must be stored in a roofed and bunded area with no external drainage. Toxic sludges must be stored in a lockable area and in lock proof containers.

The bund should be of such dimensions that it contains the volume of the largest tank it serves leaving a freeboard of at least 150 mm. In calculating the bund volume do not forget to subtract the volume displaced by the base of the tanks. The bund should be 0,6 x the height of the highest tank away from the closest tank to the bund.

The bund area should be constructed of a material resistant to/not affected by the chemicals stored in the bund. Alternatively it must be lined with a corrosive resistant material.

Should there be stormwater ingress due to the heights of the roof consideration should be given to enclosing the sides of the roofed area.

E.3 Sludge Treatment and Disposal

E.3.1. Sludge treatment/neutralisation to be carried out with lime and cement resulting in a solid product.

E.3.2 Classification of the treated sludge is carried out according to the minimum requirements for the handling ,classification and disposal of hazardous waste (DWA & F Second Edition 1998). This process entails using the T.C.L.P. Leaching test.

E.3.3 After classification the choice of landfill site is assessed (either Hh or HH) and in all probability will be assessed Hh.

E.3.4 Factory responsible for acceptable disposal to landfill.

E.4 Best Practical Environmental Option for disposal of metal sludges.

The EnviroServ proposal to develop and implement cost effective sludge treatment and disposal of metal sludges is considered to represent the Best Practical Environmental Option. However, it will be necessary to consult with all generators of metal sludges and to obtain signed commitment from them. The proposal is attached.

3. SUMMARY

In general the recommendations of these guidelines are thus:-

1. Batch tank treatment, i.e. for flows less than 20 m^3/day and controlled flow through tank system for flows greater than 20 m^3/day. Three batch tanks to be installed, each with one day storage capacity.

2. Provide correct process chemistry for a particular effluent type, provide pH measurement and adequate mixing facilities.

3. Orifice or pulsed valve discharge over 8 hours.

4. On site sludge separation and treatment.

5. 0ff-site disposal of all metal sludges to regulated solid waste disposal site in accordance with EnviroServ's proposal.

6. Waste minimisation management to be encouraged.

7. Monitoring by Metro over and above normal regulatory monitoring will be on a cost recovery basis following a phasing in period.

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