# Land Reclamation

## Toxic Discharge Control (No.)

### Definition

Control of acid or otherwise toxic aqueous discharges from abandoned mines or mine waste.

### Scope

This standard applies to acid or toxic discharges from areas that have been mined, either surface or subsurface, and is usually associated with land reconstruction (543).

### Purpose

To improve water quality, eliminate unsightly residues and odors, reduce erosion, and restore areas to beneficial use.

### Conditions where practice applies.

The standard applies to locations where acid or toxic drainage is degrading water quality and the environment in and adjacent to streams, lakes, reservoirs, or wetlands.

### Planning considerations

1. Geologic environment of the immediate area including characteristics of overburden such as lithology, faults, joints, and attitude.
2. Surface and subsurface hydrologic conditions.
3. Mining history.
4. Land use.
5. Postmining history and conditions.
6. Topography.
7. Spatial and stratigraphic location of pyrites and other sulfides.
8. Availability of limestone or other alkaline material.
9. Availability of blanketing material.
10. Use of water.

### Design criteria

There are four primary methods for controlling toxic mine drainage: (1) mine sealing, (2) infiltration control, (3) "daylighting," and (4) neutralization.

**Mine sealing.** This method is usually used to reduce the amount of water entering or to promote inundation by water of underground mine workings to reduce or prevent oxidation of pyritic materials.

In the locations where air and surface water enter underground mines, the measures used for shaft and adit closing (452) or subsidence treatment (454) can be used. Other practices such as diversions or drains can be used to keep water from the entrances. Reducing the amount of water entering the mine may solve the problem.

In the inundation process, physical barriers are constructed in a mine opening to prevent the escape of water. These seals must be designed to withstand maximum expected hydrostatic heads and be constructed of suitable materials such as masonry, concrete, grouted limestone, or clay. The double-bulkhead grouted aggregate seal has been the most successful and appears capable of withstanding large amounts of water pressure—up to 10.7 m (35 ft) of head. Sealing mines to reduce acid mine drainage by constructing wet seals at the mouths of mine portal drainways, which provides air locks while allowing water to discharge, has been tried in the past with little success.

**Infiltration control.** This method is designed to reduce the amount of water entering toxic surface materials. Gob piles and cast overburden can be reshaped for better surface drainage and blanketed with compacted, slowly permeable soil materials to deter infiltration. An intensive water disposal system is required to prevent erosion into the toxic material. Terraces, underground outlets, lined waterways, and grade stabilization structures are typically used. All surfaces should be left with positive grades to the water disposal system. Diversions may be used to reduce outside overflow. Blanketing with pulverized limestone before topsoiling and revegetating may increase the pH of the infiltrate, which inhibits the growth of *Ferrobacillus-Thiobacillus* organisms, thereby greatly reducing acid formation. Surface soils should be treated as necessary to promote a healthy root environment for planned vegetation.

**Daylighting.** This practice is surface mining the existing underground coal, selectively placing toxic materials, regrading and vegetating the area, and diverting water to natural drainageways. Daylighting has proved to be the most successful method of abating toxic mine drainage from abandoned underground mines to receiving streams. This method may work on surface mines if deeper coal seams are present that can be economically mined.

**Neutralization.** Acid or other toxic mine drainage water can be treated and neutralized by adding alkaline material to the mine drainage. By selecting the proper alkaline agent, many metal cations can be removed during neutralization as insoluble hydroxides. Several alkaline materials are available, such as hydrated lime (CaOH), caustic soda (NaOH), and limestone.

Alkaline mine drainage having a relatively high pH—in excess of 6.5—and containing predominantly iron cations can be successfully treated by aeration or adding hydrogen peroxide.

Although most of the undesirable metal cations are removed during neutralization, the water still is considered hard and requires additional treatment for beneficial use. If a proper sludge-settling basin is provided after neutralization, the product water would not be detrimental to most fish and wildlife. Chemical treatment is the least desirable measure because of the long-term nature of the action and the excessive operation and maintenance costs involved.

SCS projects will normally involve only one-time treatment to permit discharge of ponded water where this will prevent the formation of more toxic water.

**Protection and maintenance**

All disturbed areas shall be reshaped and regraded to blend with surrounding features. Visual resources must be considered in the planning, design, and installation of land reclamation projects. Exposed earth shall be covered with soil materials and established to vegetation or protected by other means. Access roads must be maintained and foot and vehicular traffic controlled. Sites must be monitored to determine the effectiveness of the work. Water sampling and pH readings should be taken at regular intervals until a steady state is established.

**Plans and specifications**

Plans and specifications for toxic discharge control shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose.

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TECHNICAL GUIDE
SECTION IV

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# Land Reclamation, Toxic Discharge Control (no.)

## Planning considerations for water quantity and quality

*Quantity*

1. Effects on the water budget, especially on volume and rates of runoff, infiltration, evaporation, transpiration, deep percolation, flow through soil openings, and ground water recharge.

2. Variability of effects caused by seasonal and climatic conditions.

3. Effects of vegetation on soil moisture.

4. Effects on downstream flows or aquifers that would affect other water uses or users.

5. The effects of the potential changes on the established water regime on and near the site.

6. The effect on the water table of the area that could increase the hydraulic head sufficiently to force underground water to the surface in some less suitable site.

*Quality*

1. Effects on erosion and the movement of sediment, pathogens, soluble and sediment attached substances, and other deleterious materials carried by runoff or translocated by seepage water.

2. Effects on the visual quality of onsite and downstream water resources.

3. Short-term and construction-related effects on the quality of downstream water.

4. Potential for uncovering or redistributing toxic and low productive soil material.

5. Effects on the movement of dissolved substances below the root zone toward ground water.

6. The effects on wetland and water-related wildlife habitats.