STATE OF NEW MEXICO
BEFORE THE WATER QUALITY CONTROL COMMISSION

In the Matter of:	)	
PROPOSED AMENDMENT TO 20.6.2 NMAC (Copper Rule)	)	No. WQCC 12-01(R)

EXHIBIT SCOTT – D-10

DESIGNING FOR TAILING DISPOSAL IN THE SOUTHWEST

Pointers on planning effective, adequate disposal areas. San Manuel found that use of cyclones saved the day when tonnage outran tailing dump space, and made for firmer dam faces as well.

by E. V. GIVEN

Designing a tailing dam is a major step toward fully integrated mill operation. In the case of large concentrators considerable planning is necessary, and the site of the tailing disposal area may very well dictate the location of the concentrator itself.

Before a suitable location can be selected several pertinent factors should be investigated: estimated life expectancy of the mine and, if possible, approximate total tonnage; knowledge of daily mill capacity; and the possibility of future mill expansion. In addition, the area should be able to store tailing for many years and, from a cost and maintenance standpoint, gravity flow will probably be desired.

ONE POND OR TWO

After an appropriate location has been selected a choice must be made on comparison of the merits of one large pond with those of two or more smaller ponds. While initial costs would probably be lower in equipping one large dam, the single dam may lack flexibility, forbidding isolation of certain areas for drying and compaction, denying use of more than one feed line for continuity of operation, and it also may be unusable in an emergency. The terrain of some locations may force the use of several dams to obtain a big enough area for the tonnage involved.

Prior to actual construction an overall picture should be drawn showing proposed dams necessary for several years of operation. An outline will be required of pipelines, flumes, drop boxes, junction boxes, and lighting for the dams. The dewatering system should go on paper showing decant lines (or proposed method of removing reclaimed water), dewater towers, settling and storage basins, pump house, and return water piping to plant storage tanks.

Optimum size of dams will be controlled by type of terrain, daily tonnage, and choice of the operator. If more than one dam is constructed overall area should be large enough to allow each individual dam to be placed on a routine operation and shutdown schedule. If only one dam is to be used it must be big enough to allow sections to be isolated for a time, for drying, compacting, and building berms.

CYCLONES CAN HELP

Minimum area required will be controlled to some extent by the type of waste material and the slime it will contain and by drying time for road and berm building equipment. At times cyclones can be used to great advantage, and with some ores they are practically an economic necessity. With ores that require a fine grind or contain considerable collodial slimes the area necessary will be decreased when cyclones are employed. Experience with cyclones at San Manuel is detailed below.

Probably no two concentrators employ the same acreage per ton per day. In most cases dams are laid out so that available acreage increases as the berms grow higher. A common mistake is to start with too small an area. Trouble is often experienced with an inadequate disposal area, wet and soggy faces, and insufficient time for drying and building berms. It is difficult to state the area necessary for a given tonnage when conditions are unknown, but as a rule a

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quired. Most large concentrators have 16 or 18 acres per 1000 tons, or more. San Manuel, at present, has only 9 acres per 1000 tons of material but cyclones are used on all dams.

BUILDING BERMS

The original berms are usually built with material from surrounding ground at the dam site or from mine waste or overburden. Use of keyways in the base of the dams is a matter of opinion—some operators claim that a keyway will trap seepage water and eventually saturate portions of the dam base. Of four dams in use at San Manuel three have keyways. Perhaps it is only coincidence, but the one without the key has given more trouble than all the others combined.

Minimum height of the earth berm depends on the slope of the storage area facing the dam. This available storage area, of necessity, will cover enough acreage to handle operations for some months. Original berms or dikes are usually constructed with a face slope of 1½:1, and the material should be compacted as the berms are built. Traffic of heavy equipment used for transporting fill will normally be adequate for compaction. The top of the berms should be wide enough for a roadway to accommodate heavy equipment and also allow space for the distribution header, pipes, valves, and so on.

SELECTING PIPE

In the selection of pipe for transporting tailing to the dams there are several types from which to choose. To avoid excessive wear, all should be installed with the least slope necessary to maintain flow of the pulp. Wood stave pipe, concrete pipe, and pipe fabricated from cement and asbestos are the most commonly used, and all give good service under certain conditions. Some types of wood stave pipe have a tendency to deteriorate, so soil conditions should be checked before a final decision is made to install this type. As a further safety measure wood lines should be treated with a wood preservative to prevent rot and ought to be installed above ground in open air where practicable. Water or pulp should be run through the pipe at all times, as deterioration will be speeded if the pipe is subjected to dry and wet periods.

With concrete pipe and cement-asbestos pipe there will be no deterioration except that caused by abrasion. Although concrete and cement-asbestos pipe may be the more expensive in initial installation they will probably prove most economical over a long period.

RECLAIMING WATER

Water reclamation is intimately associated with tailing disposal, and at most large concentrators in the southwest it is compulsory to recover as much water as possible. Water will normally collect on the low back edge of the settling area and it must be removed quickly to avoid excessive loss from evaporation, absorption, and seepage. One of the most satisfactory methods of recovering this water is through concrete ducts laid on natural ground underneath the original berm and extending upslope through the settling area. Ducts are installed at approximately 90° to the dam faces. This dewatering pipe or duct has 6 or 8-in. holes at spaced intervals along the side or on top for decantation. As slimes encroach on the open holes they are stoppered with wood or specially-made cement plugs. Round concrete water towers are built where necessary and connected to the decant lines on ducts. Towers are 5 or 6 ft ID and have decant holes around the tower, arranged in a spiral pattern. Water from the towers and ducts is routed to reservoirs and settling basins, then to pump stations where it is ultimately returned to the mill storage tanks.

TAILING DISTRIBUTION

After the disposal area has been selected and the height of the earth berms decided, it will be necessary to lay out pipe lines or flumes for transporting the tailing to different distribution points. At new concentrators in the southwest the trend appears to be in favor of pipe instead of open flumes or launders. This system is relatively simple and easy to control compared to the old orthodox method of supporting the distribution header on high overhead structures. It is more economical in all respects, and there is less down time between cycles when it becomes necessary to raise the distribution manifold.

PRACTICE AT SAN MANUEL

San Manuel uses pipe for conveyance and distribution of tailing and a description of the installation at this southern Arizona property should be of interest.

Distance from the tailing thickeners to the face of the lower dams is about 1¾ miles, with a ground slope averaging 5 pct. Pipe lines are placed on an inclination of half of 1 pct to minimize wear from abrasion, with drop boxes installed at intervals to compensate for the excessive slope. Spacing varies between drop boxes, with the longest run being 1200 ft. Heights of the different boxes are from 12 to 24 ft. Tailing leaving the thickener area averages between 44 and 48 pct solids and is carried in a 30-in.-ID wood stave line. Junction boxes are located at strategic points, where the pulp is split and sent to the dams in two 18-in. lines. All 18-in. lines on the dam faces and wings are cement-asbestos pipe.

The original earthen berms for the different dams are from 2600 to 3200 ft long. Top width is a minimum of 30 ft, to accommodate the 18-in. distribution header or manifold and an equipment service road. The header itself is installed flat and level on wooden saddles for the full length of the dam face and a portion of the wings. Flexibility is good since it is feasible to feed this distribution manifold from either end or both ends simultaneously. As two of the 18-in. pipes are needed to handle the total tonnage, this method of feeding the manifold from both ends will place all the tailing in one dam, if this is desirable.

To keep pressure up, drop boxes nearest the header are removed as the berms grow in height. A minimum of 5 or 6 ft of head is needed for each 1000 ft of header, plus the height of the berm above the header, plus an added 8 or 10 ft of head to sustain a few pounds pressure into the cyclones.

Headers are equipped with 4-in., round port, lubricated plug valves at 26 or 52-ft centers, depending on the available area behind the berm. Thin wall steel pipe connects to the valves and delivers the tailing over the berm into the storage pond area (see illustrations). Practically all the tailing at San Manuel is discharged through cyclones which are mounted on light-weight stands, 4 ft high. Stands and cyclones are placed on the inside edge of the berm, with the cyclones installed about 15° from the horizontal, sloping towards the apex or underflow discharge.

When the dam has been filled the tailing will be routed to one of the other prepared pond areas. The filled dam will be allowed to dry, cyclones removed, and a new dragline berm will be built from the sands deposited by the cones. Cyclones will again be installed and connected to the 4-in. feed lines, and the process will be repeated. Cycle time on the different dams will vary—the smaller ones may be pushed hard to gain acreage as rapidly as possible. Dragline berms will be built as soon as the sands have dried sufficiently to support the weight of the dragline equipment. The larger dams will have a rest period from one to two and one-half months, and this cycle time is growing constantly as the storage area becomes larger.

Following the described method the dams reach a maximum height of 30 to 35 ft above the distribution header. At this level a new service road is built, the distribution header is raised to the new road and relocated, and a new dragline berm is made ready.

Use of Cyclones: Before leaving the subject of berm building special emphasis should be given to the use of cyclones at San Manuel. Although overall planning and design were good, it became apparent that the area available for tailing disposal had not been sufficiently developed to handle the tonnage involved. A relatively fine grind did not help the situation, and it was readily seen that it would take many months of drying time before the tailing would support equipment. Two 12-in. cyclones were given a test run. The improvement was so evident that ten more were placed in service. Following a test period with this battery of 12 cones vs open pipes it was decided to fully equip all dams for cyclone operation.

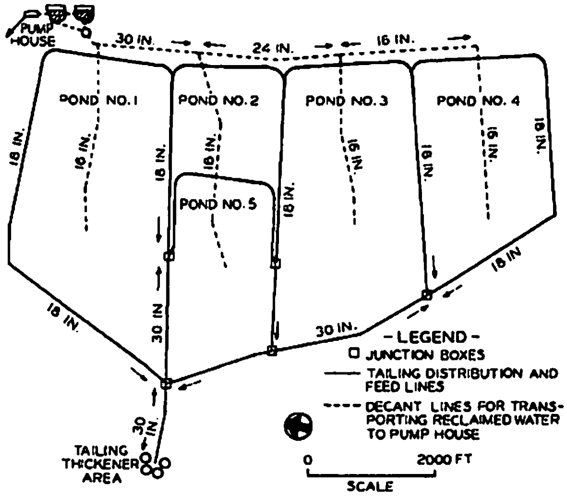
It can be truthfully said that without the cyclones it would have been necessary to curtail mine tonnage or institute a costly crash program of building and equipping new dams—perhaps both. Also, the dam faces built up from this coarser tailing fraction are considered superior to dikes made from slimes.

Water Reclamation: Reclaimed water is an extremely valuable commodity at nearly all milling operations in the southwest and San Manuel is no exception. San Manuel's dams are equipped with 16 or 18-in. dewater lines buried in the ground beneath the tailing close to the center of the storage areas, and are placed at approximately right angles to the dam faces. The water pool is collected over this line and is controlled by discharging the tailing at different points along the dam face and wings. Water is decanted through concrete towers and 10-in. standpipes connected to the decant line. The decant lines connect to a large water header or collection line below the dams which gathers water from all the ponds and conveys it to settling and storage reservoirs and the pump station.

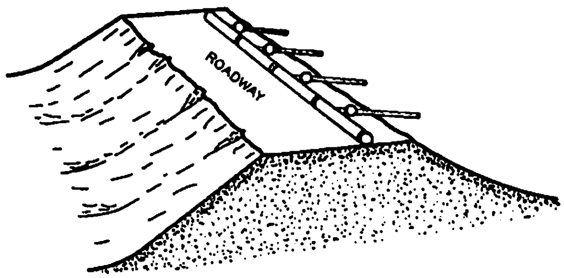
An accompanying illustration shows the general outline of all dams (in operation and proposed) and the piping necessary for a well-balanced operation. Other sketches show the method of feeding the dams, distribution manifolds, berms, and cyclone installations.

All too often insufficient thought and time is devoted to preliminary planning in tailing disposal. There can be no greater headache than trying to impound tailing in an area inadequate to handle the volume and tonnage. Disposal and storage of large volumes, maintenance of dams and equipment, and the efficiency of the operation from an economic standpoint will [illegible]

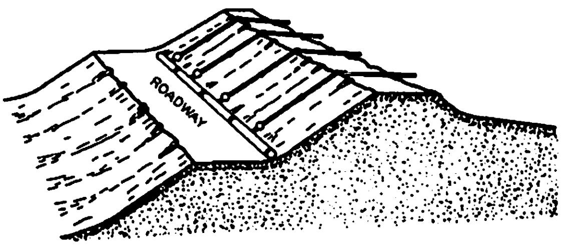
TAILING DISPOSAL AT SAN MANUEL



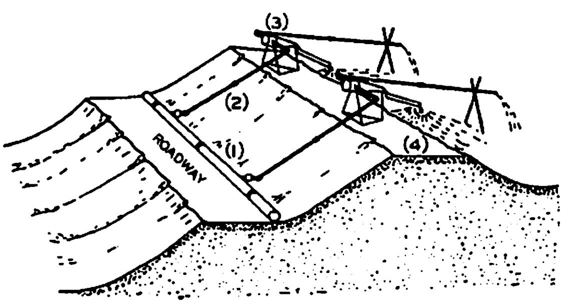
Proposed and operating tailing dams.



Original earth berm showing installation of header and discharge pipes into storage area.



Dragline berm and method of raising tailing from header over top of berm into tailing dam.



- LEGEND -
(1) TAILING MANIFOLD HEADER (3) CYCLONES
(2) TAILING DISCHARGE PIPES (4) DRAGLINE BERM