

## **Factory Waste Stabilization by Aeration On Large Fields**

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Beet factory waste is characterized by several factors which add greatly to the problem of satisfactory treatment and disposal. Among these unfavorable factors are: 1. The large volume of effluent; 2. the large amounts of mud, limecake and other suspended solids; 3. seasonal operation of factories. A complete treatment of beet factory waste necessarily includes removal of suspended solids and stabilization of dissolved organic matter.

The sewage treatment commonly employed by municipalities involves removal of suspended solids in settling tanks and subsequent reduction to B.O.D. (biochemical oxygen demand) by passing the clarified liquid over trickling filters consisting of beds of rock over which the liquid is sprayed. Growths of microorganism build up on the rock in the filter, which under favorable conditions of temperature, pH and oxygen supply, effectively attack and destroy a large percentage of the organic matter in the liquid which trickles over the mass. Trickling filters capable of handling the wastes of a 2,000-ton sugar factor must be made very large, hence are costly to build. They are, moreover, only partly effective at the beginning of operation because considerable time is required to build up the active growth of microorganisms. A less costly solution of the problem of beet waste disposal is desirable.

### **Experimental Work**

During the past two campaigns the Great Western Sugar Company has tested a modification of a procedure for waste disposal developed in Europe and used with some success at the Elsdorf sugar factory in Germany. At the Elsdorf factory, the waste is screened to remove roots and leaves and then passed through settling tanks to remove most of the mud. The thick mud is pumped to a storage area and the overflow passed through shallow ponds to eliminate most of the remaining suspended solids. Part of the clarified liquid is reused at the factory for fluming and washing beets. The remainder is passed over grass fields before it is discharged to the river. An arrangement of flumes and pumps permits diversion of the flow to a series of fields. In the usual operation one field is flooded for eight hours and then allowed to drain.

Experience at Great Western Sugar factories has demonstrated that settling ponds quickly develop considerable odor. It was decided therefore to attempt to carry out the Elsdorf plan without ponds. The installation was made at the Bayard, Nebraska, factory, where about 100 acres of gently sloping land (1,400 feet wide by 3,300 feet long), lying immediately below the factory were available. The installation was simple. The waste was conducted to the upper edge of the field by means of a ditch. It was pumped from the ditch to a flume 1,400 feet long, built on an earthen dike about 8 feet high extending along the upper edge of the field. During the first year the waste was discharged to the field from the flume through short steel pipes four inch in diameter, placed at 50-foot intervals in the side of the flume. These pipes rapidly became plugged with roots and leaves and it was necessary to have a man constantly at the flume to keep them

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open. The pipes were replaced by open ducts during the second season. The distribution of the waste to the field was accomplished thereafter with little difficulty.

#### **Results**

The Bayard factory slices 1,900 tons of beets daily. It has a pulp dryer but not a Steffen house. Approximately 8 cubic feet of waste per second flowed into the aeration field. This waste contained all of the lime cake, flume and beet washer water, screened pulp water and pulp press water. Tests made by the Great Western Sugar Company's Research Laboratory and by the U. S. Public Health Service in 1949 show that the total B.O.D. in wastes from a beet sugar factory operating under these conditions amounts to 15 to 20 pounds per ton of beets. Results obtained in the tests conducted this year (1953) confirm those obtained previously. Data taken two weeks after the start of the campaign, and at three-week intervals thereafter, show 15 to 18 pounds B.O.D. per ton of beets sliced in the wastes discharged from the factory. The concentration of B.O.D. in the factory waste ranged from 787 to 600 parts per million. The B.O.D. concentration in the effluent from the field ranged from 143 to 320 ppm., indicating percentages of reduction of B.O.D. ranging from 80 to 40. The average reduction was about 70 percent.

Elimination of B.O.D. was more complete during the first part of the campaign, when the air temperature was about 63° F., than it was later when temperatures were near freezing.

It was observed that substantially all of the suspended solids were deposited within 100 feet of the inlet flume. One series of samples taken about 300 yards from the flume showed reductions in B.O.D. amounting to about 50 percent. It is probable that much of this reduction is accounted for by the deposition of lime cake and trash with the flume mud in the upper part of the field where it will remain to become part of the soil.

The field should have been levelled prior to the test, but in order not to disturb (the natural grass it was left in its original state. Unevenness of the field caused considerable variation in the depth of water at different locations as well as in the rates of flow. It is estimated that not more than half of the total area was used effectively. The grass stems were quickly festooned with bacterial growth on those areas of field where the depth of liquid was sufficiently low. The grass served the twofold purpose of supporting bacterial growth and of increasing the area exposed to air.

Very little odor developed on the field.

#### **Discussion**

The waste disposal experiment at Bayard indicates that at factories where suitable land is available, removal of suspended solids and appreciable reduction of B.O.D. content may be accomplished in a single operation. Although the procedure is more effective in warm weather than in cold, considerable reduction in B.O.D. occurs even in freezing weather.

This method of factory waste disposal by itself may not be a complete solution of the beet factory waste disposal problem. It appears, however, that the B.O.D. discharged to the stream may be held below 5 pounds per ton of beets sliced at factories which do not have pulp silo drainage or Steffen waste.