Circular No. 4 1929

Control of Scum in Sewage Tanks.

BY

A. M. Buswell

[Printed by authority of the State of Illinois]
DEPARTMENT OP REGISTRATION AND EDUCATION
STATE WATER SURVEY DIVISION
A. M. BUSWELL, Chief
Urbana, Illinois

ORGANIZATION

STATE OF TI.LTNOIS

Lours L. EMMERSON, *Governor*

DEPARTMENT OF REGISTRATION AND EDUCATION

M. F. WALSH, *Director*

Board of Natural Resources and Conservation Advisers

M. F. WALSTT, *Chairman*

WILLIAM A. NOYES, Chemistry, *Secretary.*
JOHN W. ALVORD, Engineering.
EDSON S. BASTIN, Geology.
HENRY C. COWLES, Forestry.
WILLIAM TRELEASE, Biology.
C. M. THOMPSON, Representing the President of the University of Illinois.

State Water Survey Division Committee

M. F. WALSH
C. M. THOMPSON
WILLIAM. A. NOYES
JOHN W. ALVORD

STATE WATER SURVEY DIVISION

A. M. BUSWELL, *Chief*

with proper connections one small motor and pump could.be made to serve a large number of gas vents by pumping to one at a time.

(3) The method is effective. It remedied the most aggravated case which has come under the writer's observation.

Acknowledgment

The writer wishes to acknowledge the assistance of Harry E. Schlenz, engineer, and Sidney L. Neave, chemist, in carrying out these experiments. He also wishes to express his appreciation of the large scale experiment carried out by Doctor Hatfield.

Reprinted from Vol. 21, Page 322, April, 1929

Industrial and Engineering Chemistry
Published by the American Chemical Society

Control of Scum in Sewage Tanks[1]

A. M. Buswell

STATE WATER SUKVBY DIVISION, URBANA, III.

IN THE purification of sewage advantage is usually taken of the fact that 20 to 30 per cent of the organic matter may be removed by sedimentation or settling for a period of 1 to 3 or 4 hours. The settled sludge contains from 90 to 99 per cent water, usually the higher figure. It quickly becomes foul and must be submitted to bacterial fermentation and digestion, which reduces it to an inodorous humus. In the majority of plants the action goes on smoothly and without difficulty. But occasionally the digestion process is accompanied by the formation of scum or foam or both. When this occurs the operation may be upset or even completely interrupted.

The Scum Problem

The gases, largely methane and carbon dioxide, which are formed during digestion lift a variable portion of the sludge to the top of the digestion tank, forming a scum. This scum appears to form more rapidly in hard-water regions, where the sewage contains a considerable amount of lime soaps. Extraction with petroleum ether shows that scum contains much more "grease" than the sludge from which it is formed. It naturally contains matches, corks, vegetable peelings, and other similar matter. The greasy and fibrous material may form a stiff scum of considerable thickness.

When open tanks are used for digestion, the scum appears to reach a certain maximum thickness and is left undisturbed. Its presence is supposed to favor the digestion process. Channels are formed here and there through which the gases escape and no operating difficulties are encountered. But when

[1] **Presented before the Division of Water, Sewage, and Sanitation Chemistry at the 76th Meeting of the American Chemical Society, Swampscott, Mass., September 10 to 14, 1928.**

Imhoff or "two-story" tanks are used it is necessary to provide gas vents, which take up from 20 to 30 per cent of the space that would otherwise be available for sedimentation. Even with this provision the accumulation of scum may interfere with the operation of the sedimentation chamber; and when the digestion tank is covered for the purpose of collecting the gases,[2] the scum may collect in the restricted area beneath the dome of the gas collector and prevent the escape of gas.

Such a condition arose in an experimental installation (Figure 1) built for the study of the chemistry of sludge digestion. The tank had a capacity of 1900 gallons and received about 30 gallons per day of fresh sludge of 97 per cent moisture content from a sedimentation tank. The scum reached a thickness of 26 inches in about a month. It had a moisture content of 80 per cent and was so stiff that a shovel was forced into it with difficulty. The liquor expressed from the scum had a pH of 5. The installation of a grid beneath the gas dome to hold the scum submerged as suggested by Imhoff[3] did not solve the difficulty. The grid soon became clogged and the escape of the gases was prevented. Wooden arms turned by a crank from the outside were installed to break up the scum. When the arms were rotated slowly several times a day for 3 to 5 minutes at a time, no improvement was observed. When they were rotated rapidly, they whipped up a froth that filled the whole collecting dome.

Besides mechanical means, there are three obvious ways by which a gummy scum or colloidal gel of this sort can be softened and disintegrated. All three depend on decreasing the viscosity of the material:

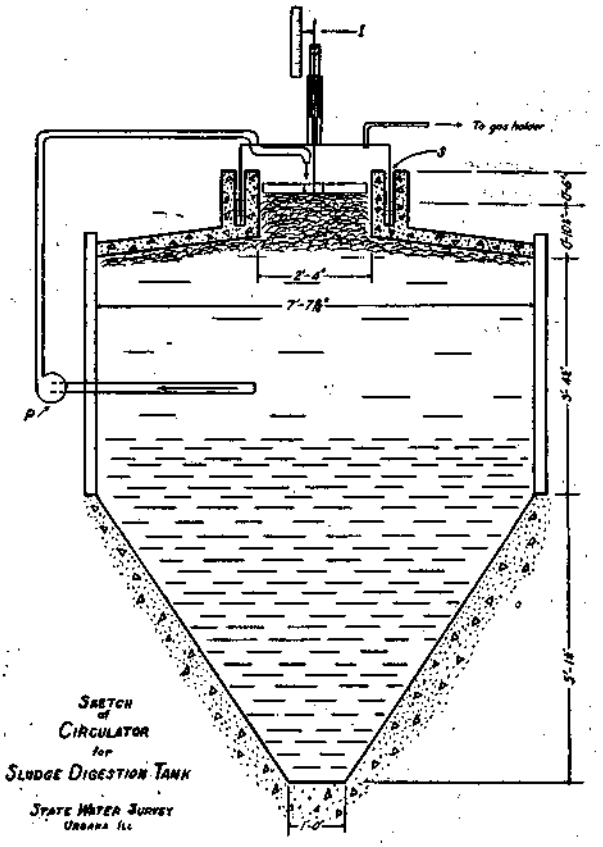
(1) It is known that many organic substances change their viscosity with change in pH; this is especially true of their water emulsions. The use of lime to aid sludge digestion has been known for many years and whatever beneficial action it has is no doubt due in part to this effect.
(2) Heating lowers the viscosity of gummy material such as that under discussion.
(3) Dilution of a colloid with the continuous phase will lower viscosity.

The use of lime was not suitable, since it would change the chemical conditions of the experiment. Heat has various effects on the processes of digestion as well as on the viscosity of the medium. Its use was not attempted. Dilution was found effective, but the volume of water required was too great to be practical. In many plants scum is reduced by hosing, but in some cases the cost for water is an appreciable item.

Since the scum is practically a gel, it seemed likely that the liquor from which it had separated might serve to dilute and soften it. A pump and pipe connections were installed

[2] **Busweil arid Strickhouser, IND. ENG. CHUM, 18, 407 (1926).**
[3] **Imhoff," "Fortschritte der Abwasservereingurig," Carl Heymariria Verlag.**

(Figure 1) so that liquor from beneath the scum could be pumped up and allowed to flow onto the scum in a gentle stream. One-inch pipe was used, the rate of pumping was 10 gallons per minute, and the discharge pipe was placed 2 to 3 inches above the scum. The operation was carried out so as to avoid all violent jet or spray action, since experience had shown that such action resulted in extensive foam formation. Ten days' circulation under these conditions completely disintegrated a 26-inch layer of stiff scum,



and the gases evolved during digestion were allowed to escape smoothly into the gas collector. After the scum had once been softened and disintegrated, it was found that circulation for from 5 to 10 minutes a day prevented any further scum formation.

The Foam Problem

Sometimes the fermentation of sewage sludge results in the formation of froth or foam rather than scum. Foaming appears to be rather spasmodic and of variable intensity. When it occurs in tanks with restricted gas vent areas—e. g.,

Imhoff tanks or tanks provided with gas collectors—it may completely upset the operation of the plant. The writer has seen foam coming out of the vents of an Imhoff tank like the froth out of a bottle of warm soda pop. In tanks equipped with gas collectors the foam will sometimes fill the gas dome, clog the delivery pipe, and force its way out through the water seal running "all over everything."

The factors which bring about this condition during sludge digestion do not appear to be the same in all cases. However, the formation and stability of any foam depends upon the viscosity rather than the surface tension of the film. The rate of violence of foaming will depend on the rate of gas formation.

Since it is known that the liquid in the froth film in such cases is more concentrated than the liquor from which the foam is formed, it seemed possible that circulating the liquor as was done in scum control would dilute and break the foam. As an experiment a vigorous foaming was produced in the tank under observation by raising the temperature to 37° C, thus greatly increasing the rate of gas production. After a few hours the foam broke the water seal, *S,* and flowed over the top of the tank. The circulating pump, *P,* was then started and within 3 minutes the foam level had subsided 7 inches, as shown by the indicator, /. Thereafter it was possible to control the foaming by starting the pump whenever the indicator showed that the level was rising. Circulation for 3 to 5 minutes at a time was sufficient to break the foam and routine circulation for 5 to 10 minutes per day was usually sufficient to prevent foam formation.

Hatfield[4] reports a test on the control of foam by circulation in an Imhoff tank as follows:

> A somewhat similar arrangement (to that described in this article) was installed in four of the eighteen gas collectors of a badly foaming Imhoff tank. During six weeks' operation the foaming seemed to be so well controlled that connections have been placed in all the 108 gas collectors of the six-tank plant. Circulation for scum and foam control is now in use on one tank (18 collectors) and permanent connections to all gas holders are contemplated.

Lime treatment is usually effective in controlling foaming but in aggravated cases the quantity required is high, amounting in one case to one hundred dollars worth per day. Circulation cost for the same plant is estimated at five dollars per day.

Advantages of Method

This method of scum control has the following features in its favor:

(1) The power costs will not be high, since the pump lifts against a head of only 2 or 3 inches plus the friction in the pipe.

(2) The installation cost should not be excessive, since

[4] **Hatfield, private communication.**