REMOVAL OF GREASE FROM MEATPACKING PLANT WASTEWATER USING A CENTRIFUGAL SEPARATOR

MASTER THESIS

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INTRODUCTION AND BACKGROUND

A. INTRODUCTION

The United States Department of Agriculture has recently reported that the meat slaughtering and packing industry poses the number one potential pollution source in the food packing and related industries. It is second only to the pulp and paper industry in terms of the Biochemical Oxygen Demand (BOD) load which could be placed in the streams of the United States.

One of the major factors contributing to this large BOD loading is the high quantity of grease present in the process wastewaters of meatpacking plants. For the purposes of this paper, grease will be defined as the material extracted from an acidified sample utilizing a modified Soxhlet procedure with n-hexane as the solvent at a temperature of 85^{o} C. This definition may create difficulties in comparing this work with previous investigations due to the various procedures used over the years. However, it is felt that the evaluation of a system is not so dependent on testing procedures that valid comparisons are not possible.

While studies conducted during the previous forty years have indicated that grease is a biodegradeable component of

wastewaters, this project was initiated for investigating a physical method for the removal of grease from wastewater. There were two reasons for this approach: first, the biodegradation of complex greases requires much more time than is usually provided in conventional waste treatment processes, and secondly, the grease which is removed from meat packing wastewater represents a valuable by-product which is usually rendered into inedible tallows.

Physical methods for the removal of grease have been used for many years. They are widely varied and include: pressure flotation, vacuum flotation, aeration, and skimming tanks(2). Most of these methods have been developed for the separation of grease from domestic wastewater or oil refinery wastewater. Neither of these types of wastewater have the quantity of hexane solubles commonly found in meat packing plant wastewater nor the overall amount of organic material which characterizes this type of wastewater. The purpose of this project was to investigate the feasibility of using a centrifugal separator for removing grease from a meatpacking plant wastewater. These studies were conducted on the process wastewater generated by the Peyton Packing Company of El Paso, Texas.

B. BACKGROUND

A general study of the Peyton Packing plant revealed it to be a medium-sized operation, slaughtering and dressing four hundred fifty head cattle per day. The plant also pro-

cesses two thousand dressed hog carcasses per week and generates 0.450 MGD of process wastewater. During the course of the research study, much work was done to characterize the wastewater and the results of three diurnal sampling periods and numerous short term sampling periods indicated that the average concentrations of the most important parameters were as follows:

Table 1 AVERAGE CHARACTERISTICS OF PEYTON'S WASTEWATER

PARAMETER	CONCENTRATION (mg/l)
BOD	2600
COD	5300
TOTAL KJELDAHL NITROGEN	110
TOTAL SOLIDS	3450
SUSPENDED SOLIDS	1600
GREASE	1280

CHAPTER TWO

REVIEW OF THE LITERATURE

During the past forty years numerous investigators have directed their attention toward the problems encountered in the treatment of wastewaters containing large quantities of grease. While it has been demonstrated by these investigators that conventional methods of secondary treatment will adequately treat grease-laden wastewater (3,4,5,6), there are serious problems which can be avoided by removing the grease and treating it separately.

Nelson and Laver(3) reported from their studies using trickling filters that the principal problems with wastewater containing grease is the carry-over from the primary clarifiers. The grease has a tendency to coat the filter stone and zoagleal slime, resulting in reduced efficiency and anaerobic conditions.

Heukelekian(4) has shown that activated sludge systems will seemingly treat a greasy wastewater efficiently. In his study using activated sludge with a mixed liquor volatile suspended solids concentration of 1250 mg/l, a 90% reduction in grease concentration was noted in the mixed liquor after four hours. However, most of this grease was retained in the sludge with only some small loss of grease reported. He also

observed that the removal increased as the suspended solids concentration in the mixed liquor increased. Heukelekian concluded that the removal of grease resulted from a physical process, adsorbtion, rather than from any biological process. The biodegradation of the grease would then occur in the digestion process.

Heukelekian and Mueller(5) in studying lipid decomposition in anaerobic digesters noted that grease was one of the major components of raw sludge and the greatest amount of gas production was due to the biodegradation of the grease. They found that only a 50% reduction in grease concentration had been effected after a detention time of forty days.

Eddy(6) reported that for the reasons mentioned by other investigators grease should be removed from an influent wastewater and treated separately. He noted that not only did grease have adverse effects on secondary treatment units but also that it had adverse effects on the operation of primary treatment systems. Fine screening systems clogged rapidly requiring frequent cleaning and higher operating cost. The agglomeration of grease with other solids in sedimentation tanks resulted in the formation of excessive scum.

In 1953, Pomeroy(7) reported on research he had done with a view toward determining the natural flotability of oil and grease in order to determine design parameters for separation systems. He determined that due to the

variability of wastewater composition, individual bench scale testing was required in order to determine the proper method for each situation. He did report that if care was exercised to insure dynamic similitude between the bench model and the prototype, accurate predictions could be made from the model studies. Pomeroy concluded that, in general, for grease separation units the critical design parameter was the overflow rate, and that unlike sedimentation tanks the detention time was not critical. The latest edition of Sewage Treatment Plant Design(23) by the Water Pollution Control Federation still maintains the aeration approach. In designing aeration basins for grease removal it is recommended that a circular or rectangular tank four to nine feet in depth with an overflow rate of 600 to 2000 gallons per day per square foot be utilized.

This type of aeration can normally be expected to be 65% efficient in the removal of grease from domestic wastewater. This efficiency cannot be approached, however, when extremely high concentrations of grease are present. For this reason, methods which can achieve high efficiencies when grease concentrations are excessive have been studied extensively in recent years. According to Hansen and Gottas(9) the principal method which has been studied is flotation.

Flotation of suspended and colloidal solids is accomplished by the attachment of fine air bubbles to the surface of the solid particle. This will result in the particle rising to the surface due to bouyant forces. The