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CHARACERTIZATION OF EFFLUENTS FROM A DEHYDRATED FISH AND MARINE SOUP PLANT: TORO A/S RIEBER & SON, BERGEN

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1. FOREWORD

This report gives a description of the effluents from a dehydrated fish and marine soup plant under construction by Rieber & Son, Bergen, Norway. The description is based on information given by the constructor, combined with results from analyses of the major components in the effluents.

With the exception of dehydrated fish powder, the processes employed in a plant like this are dry processes. The maximum of pollution comes from the daily and weekly cleaning. The total pollution from the plant is therefore dependent on how the cleaning is carried out.

Oslo, March 30, 1973 Einar Lagset

2. INTRODUCTION

For delivery to Technopromimport, Moskva, Toro A/S Rieber & Son, Bergen, have designed a plant for making dehydrated fish and marine soups. Since the productive drainage from the plant has to satisfy certain requirements, the Norwegian Institute for Water Research was asked to assist in the estimation of the composition and amount of effluents. In addition to knowledge about the water consumption and time taken over the various cleaning processes, data were also needed about the biological oxygen demand of raw materials and the end product; the different fish soup recipes.

Before analysis, fish powder and five different soups were given a treatment similar to what they would encounter in the plant process and cleaning process. Except for the analytical results all other figures were provided by the plant constructor.

3. CHARACTERIZATION OF THE EFFLUENTS

Based on flow figures, partly measured and partly estimated, and analytical data, the amount and composition of effluent in four different situations during the week are given. These situations are as follows:

a) Night time (14 hours) with only fish line on operation,
b) day time with cooling and sanitary installations in use,
c) daily cleaning, one hour between the shifts three times in 24 hours, and
d) the weekly cleaning 2-3 hours normally on the end of Friday.

The results are presented in table I.

The analyses of both fish soups and fish powder gave a mean value of BOD_5 = 500 mg O/g solid.

4. COMPOSITION OF POLLUTING MATERIAL IN THE EFFLUENTS

The impurities in the effluent water may either come from raw materials, from the manufactured products or from detergents used in the cleaning processes.

TABLE I

Characterization of the effluents

(Basic data[x])

	a)	b)	c)	d)
1) Suspension mg/l	7 000	700	120	300
3) BOD_5 mg 0/l	3 500	390	65	165
4) Fat mg/l	Nil	Nil	2	max 10
Total water volume in actual period m^3	5.6	39	77	116
Mean effluent volume m^3/h	0.4	3.9	14	60
Total solid in effluent kg per week	203	150	55	36

a) Only fish line in operation (night time 14 hours)

b) Day time except cleaning period. (10 hours.)

c) Daily cleaning between shift (3 x 1 h in addition to b)

d) Weekly cleaning (e.g. 2 hours before week-end in addition to b)

Not tabulated data:

2) pH is all time near neutral.

5) Ethereal soluble substance is expected to be of the same magnitude as fat.

6) Iron and 7) chromium are neglectable.

x) According to letter no. 5671-1/194, March 12, 1973.

4.1 Raw materials

Fish powder is produced by a continuous process in the plant. A wet scrubber purifies the air from the spray dryer system. This is the only continuous polluting process. All other raw materials are in a ready-to-use state.

4.2 Fish soups

Five different fish soup recipes are available; fish soup, piquant soup, West-coast soup, fish soup with vegetables, and fish soup with vermicelli. Since the recipes of these soups were known, there was no need for further analysis.

4.3 Detergents

A similar plant i Bergen used about 30 kg of a Norwegian brand of detergent per week. Different water quality, eg. hard water, and various cleaning routines may lead to the use of different amounts of detergents.

5. COMMENTS ON THE EFFLUENTS

5.1 Continuous effluents

The wet scrubber used in connection with the spray dryer is highly effective and produces effluents containing a high concentration of fish powder. Although the concentration exceeds the given limit, the effluent is not deleterious in a biological water purification plant. The water from cooling engine parts could be used for diluting the effluent, but it is better to dispose of this directly to the recipient.
Even with some dilution the concentration of solid material is fairly high, but the small particles (< 100 µm) will keep in suspension for a long time.

Laboratory activities, particularly those concerned with the soup testing, and also the personal sanitary installations are móre or less continuous, but these contribute little to the total pollution.

TABLE IIa

Composition of fish soups

(Summary)

Total solid	70 - 100 g/l	
Fat	5 - 7 g/l	7%
Soluble substance (cold) max.	15 - 20 g/l	20%
Insoluble		80%
Biochemical oxygen demand (5 days)	0,3 - 0,6 mg O/mg solid[x)]	

x) 0,5 mg O/mg solid is used for calculation.

TABLE IIb

Composition of fish powder

Insoluble matter		≈ 100%
Fat		∿ Nil
Biochemical oxygen demand (5 days)	0,5 mg O/mg solid	

TABLE III

Continuous effluents

	Volume m^3/hour	Concentration of solid mg/l	Type of solid
Scrubber (Venturi)	0,4	7 000	Fish powder < 100 µ
Mixing stations	2,0	-	- 2)
Sanitary installations	~ 1,5	1)	2)
Mean value	3,9	700	

1) Estimated value (BOD_5) 100 mg O/l.

2) Day time, approx, 10 hours.

5.2 Daily cleaning

Some of the plant parts are cleaned between every shift, i.e. three times every 24 hours. This will give an uneven distribution of the effluents, but with concentrations well below the given limits.

5.3 Weekly cleaning

Every week the whole plant is given a thorough clean. This is usually carried out on a Friday and takes 2-3 hours. Compared with the overall low water consumption in the plant, the peak in effluent during times of cleaning may seem fairly high. This maximum effluent may be reduced by building buffering systems. The concentrations of the different components in this water are, however, below the given limits. A buffering system would give acceptable concentrations (suspension and BOD_5) during night time with low water flow.

6. ANALYSIS OF FISH AND MARINE SOUPS

6.1 Practical procedure

Fish powder: The fish powder was put through a sieve of 50 µm. 600 ml of a solution containing 1 gr fish powder per litre was prepared by mixing the powder with distilled water at 60 °C. The mixture was shaken for 1 hour and dilutions of 1:75, 1:150, and 1:300 were taken for analysis.

Fish soups: The five different fish soups were finely ground in the mortar and 600 ml of a mixture containing 10 gr finely powdered fish soup per litre distilled water at 60 °C, was shaken for 1 hour. From these standard solutions dilutions of 1:750, 1:1500, and 1:3000 were taken for analysis.

The analysis took the form of a conventional biological oxygen demand method. The dilutions were saturated with oxygen and titrated after 5 days.

TABLE IV

Daily cleaning effluents

	Volume m^3/h	In 24 hrs. Total volume m^3	In 24 hrs. Tot.amount of solid kg	Type of solid
Fish boiling line	8	24	5	Fish
Washing room	11,3	35	2	Soup powder
Fishblock input	4	16	2	Fish
Laboratory	-	2	2	Soups
Total		77	11	

Mean content 130 mg solid/l.

TABLE V

Weekly cleaning effluents

	Volume m^3/h	Total volume m^3	Amount solid kg	Type of solid
1. floor	4 - 12	16	2,5	Powder
2. floor	8	16	2	Powder
3. floor	12	24	2 - 3	Powder[x]
4. floor	28-36	60	29	Powder and fish
Total	Mean 60	116	36	

Mean content 310 mg solid/l. Parts of the solid are soluble, and the value for suspension are approximately 300 mg/l.

x) Included 1 kg fat every 2. week in effluent from installed fat separation.

As an extra control, one of the soups (no. 3) was boiled according to the instructions and then diluted down to 10 gr per litre. The same dilutions as used previously were taken for analysis.

6.2 Results

The results are presented in table VI. The value used for calculation is 500 mg O/g solid both for soup - and fish powder.

TABLE VI

Analysis of biochemical oxygen demand (BOD_5) of fish soups and fish powder

Analyzed matter	BOD_5 mg O/g solid
Soup no 1	600
" " 2	350
" " 3	580
" " 4	390
" " 5	300
Fish powder	500
Boiled soup (no 3)	530 x)

x) The soup powder in this case was not ground.

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