Some Technological Aspects of Menhaden Products

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Broadly speaking, the technology of menhaden covers every phase of the reduction industry. It enters into methods of extending the life of nets, in preserving the catch at sea and in studying the details of the process of reducing the fish into useful products. It is used in measuring the extent of raw material losses and in studying menhaden fish meal, condensed solubles and fish oil. In addition there is the constant hope of extending the number of basic products derived from menhaden as well as increasing the range and extent of utilization. Obviously it is impossible to cover all of this ground in one paper. The Wallace Menhaden Products Laboratory has issued the following mimeographed reports which may be obtained upon request:

1. A review of the research activities of Wallace Menhaden Products Inc.
2. A technical bulletin on menhaden fish scrap and meal.
3. A technical bulletin on condensed menhaden fish solubles.
4. A technical bulletin on menhaden fish oil.

Technical work specifically on the subject of menhaden has been somewhat sparse. The reduction process is basically a simple one, involving cooking the fish, and pressing, drying, centrifuging and evaporating the product. These steps closely resemble well-known chemical engineering unit processes.

Some of the preservation problems encountered in the menhaden industry have been studied on other species of fish by scientists working in countries as widely separated as Canada, Norway and South Africa. Sometimes baffling plant problems are encountered, particularly in producing condensed fish solubles, but it is surprising how a few well known laboratory tests can clarify a situation and point the way towards a solution.. Attempts to find new uses for the raw material reveal a surprising similarity between projected uses and what has already been done in utilizing casein, meat products, soybean, and vegetable drying and semi-drying oils. Thus the chief job of a menhaden technologist is to resolve the problems into basic elements and then apply much of what is already known.

Six items from the files of the Wallace Menhaden plant are cited to help illustrate the nature variety of the problems:

1. Raw material losses are a constant concern in menhaden reduction plants. Even before the fish reach the raw box, there is a big loss resulting from the method of flooding the holds of the boats and then pumping out the fish. The water is separated from the fish before reaching the raw box and the oil and protein loss is often surprisingly large. To estimate this loss freshly caught fish were scrubbed with distilled water and the amount of protein removed in relation to the weight of the fish was determined. This was equivalent to one ton of fish meal for every million menhaden caught. Since this is the best rather than the worst conditions the normal loss is high.
2. The moisture content of menhaden fish scrap and meal is an important factor in shipping since consumers unanimously prefer protein to water. It was disturbing, therefore, when one of the Wallace Menhaden plants

began to encounter damp fish scrap. The scrap was leaving the steam dryer in good condition and from there was being picked up by a pneumatic conveyor and blown for a distance of 300 feet to the scrap shed. At this point it was being ground and bagged, having cooled on the way. The trouble seemed unpredictable. At times it happened on damp days, but not always. The grinder operator supplied the necessary clue. He had observed that it usually occurred on especially cold days. Temperature and humidity tests showed conclusively what was happening. Moisture laden air from the plant was cooling on the way to the scrap shed and releasing its water to the scrap. A tinsmith with 12 feet of pipe eliminated the problem by making possible the use of air from the outside.

3. Some pressing problems have been encountered in the production of condenced fish solubles. Operators in other companies have reported difficulties with small fish, involving "scaling" of the tubes, involving deposition of hard material. Fortunately, small fish came late in the season. There had been several months without a serious scaling condition, but when it developed we had to shut down for the tedious job of boring out tubes. The scale was found to be largely compounds of calcium, magnesium and phosphorus apparently brought about by the high proportion of bones of the small fish. A change of operating procedure measurably reduced the problem for the rest of the season.
There are times when stick water will foam and thereby reduce the speed of evaporation. One morning this situation developed in our evaporator and almost stopped the production of solubles. Fortunately, there was a tell-tale sign of what had happened. The condensate from the evaporating stick water had turned blue, indicative that the copper tubes were being attacked by a substance which did not belong in the system. It turned out to be ammonia. Adjustment of pH with enough acid to tie up the free ammonia eliminated the foaming, and evaporation resumed at normal speed.
4. In menhaden reduction plants it is common for certain components of the fish to tend to separate in the course of the process. The Wallace Menhaden Products Laboratory has studied this problem. The separation occurs as a result of differences in specific gravity and some potentially valuable materials are concentrated in this way. One substance that tends to keep part of the oil tied up in the stick water, turns out to be an excellent emulsifying agent and could be isolated for such a use. At another point there is one which shows promise as a starting material in the synthesis of caffeine.
5. The differences in specific gravity of some components of menhaden led to a process for which a patent has been applied. In some respects it is similar to flotation methods used in the mining industry, by which one material is floated in a liquid while the other sinks to the bottom, because of differences in unit weight. In a like manner, parts of menhaden can be fractionated by mixing the dried meal in a liquid of suitable specific gravity which permits one portion to float and another to sink. In its broadest application it appears that the low specific gravity fractions are highly nutritious as protein concentrates and may, in addition, be capable of competing with casein in the field of plastics, adhesives, paper coating compounds, in textiles, etc. Along more academic

lines, in applying the flotation principle in the laboratory we may have found a useful way of evaluating our products, and perhaps of predicting the quality of proteins in fish meals. Much work remains to be done on this particular point.

6. In 1864 Dana reported to the Maine Board of Agriculture, that cattle are an effective means of converting objectionable fish residues to a readily useable form of manure. He was ingenious in recognizing a double objective of supplying nutrient and of obtaining a valuable fertilizer. Fortunately, there are now more economical ways of processing and using raw fish, but Mr. Dana's point was well taken. The use of natural processes continues to offer vast possibilities. Menhaden materials are excellent nutrients and organisms have been grown upon them to increase their feeding value. It is believed that mushrooms can be nurtured in menhaden stick water. It is known that is can be used to improve range land. It is hoped to work out nutrients suitable for bacteriological processes resulting in important chemicals and pharmaceuticals. In fact, the range of possibilities seems bounded only by the limits of imagination.

Tomorrow's By-Products

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Any discussion of the "by-products" of the menhaden industry would be brief since the industry does not currently produce anything that is strictly a by-product. All of its products are primary. However, because fish meal, solubles and body oils are so classified by other producers as well as the U.S. Fish and Wildlife Service, this term will be used in the present paper.

The basic products of the menhaden industry have been the same for 100 years, with the exception of the stickwater. This long record of stability would seem to indicate that no abrupt changes should be expected. However, we may be approaching just such a time.

In almost every field of science, engineering and industry research and developmental activity is at a high pitch. Since we have an economy that is responsive to new products and methods, as the findings of the various groups are made known to each other, the effects are far reaching and rapid. Because of this ferment in the scientific world it is important that every manufacturer be alert to trends and that he actively plan to ajust his process to take advantage of new discoveries.

Here are a few examples of recent developments that may have an effect on the menhaden industry, adverse or beneficial.

1. Agriculture provides the largest market for menhaden products, and agriculture is being revolutionized. By the addition of about one twentieth of one per cent of a chemical soil conditioner the tilth of some soils is semi-permanently improved to the extent of increasing crop yields 20 to 80 per cent.
2. The Carnegie Institution is engaged in research on a process for the