



## **The 8th International Conference on Environmental Engineering and Management – ICEEM08**

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# DETECTION OF FISH CANNING INDUSTRY WASTEWATER MAIN POLLUTION SOURCES BY CLUSTER ANALYSIS

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Water consumption in fish canning industry and the production of high polluted wastewaters are of great concern worldwide. In fact, in this type of industry a huge amount of water is used throughout all steps, including cleaning, cooking, cooling, sanitization and floor washing. It is also known a frequent change of raw material to be processed, with variation in flow rates and composition, which implies changes in wastewater characteristics. These variable operating conditions make the planning of a common treatment plant for all of the wastewaters produced in a single unit a challenging task. A treatment process suitable to treat this wastewater must be found in order to fulfil the limits imposed by the Portuguese legislation (Decree-Law No. 236/98) for industrial wastewater discharge. Therefore, it is important to analyze what are the main pollution sources of this type of wastewaters to be possible to identify its main characteristics in a quick and inexpensive way, in order to define an adequate sequence for its treatment.

Cluster analysis allows grouping various objects into clusters on the basis of similarity or dissimilarity, with the purpose of reducing a set of data. Similarity of objects is determined by a correlation coefficient. On the basis of clustering, methods of cluster analysis are classified as hierarchical or non-hierarchical methods. Hierarchical methods are based on the hierarchical systematization of objects and their clusters. Given an initial cluster, first the two clusters that are nearest are merged to form a new cluster. This is repeated each time merging the two closest clusters, until just one cluster, of all the data points, exists. The levels of similarity at which observations are merged are used to construct a dendrogram.

Cluster analysis was used in this work to define important parameters to identify main pollution sources of fish canning wastewater with the minimum costs involved. To that, firstly, an exhaustive wastewater characterization was made, in order to take into account the problems of wastewater variability, and to achieve a more correct wastewater characterization. This way, 20 wastewater samples were collected in a fish canning industry of northern Portugal at different time periods (from November 2013 to June 2014) and were characterized in terms of 19 physicochemical parameters according to the Standard Methods for the Examination of Water and Wastewater. To insure that all parameters are non-dimensional and to eliminate differences in magnitude to be possible

to make a correct cluster analysis, each parameter was normalized, achieving a new data set with zero mean and unit standard deviation. After that, parameters (pollution sources) were grouped in clusters in terms of their nearness or similarity. The resulting dendrogram can be observed in Fig. 1, achieving 7 main clusters (groups).

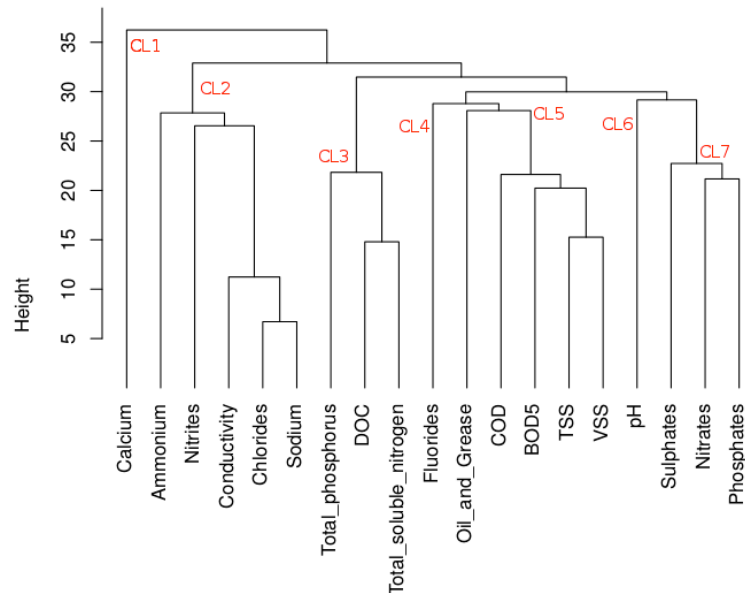


Fig. 1 – Cluster analysis dendrogram of fish canning industry wastewater parameters.

The first cluster (CL1) corresponds only to the calcium parameter. The second cluster (CL2) has two sub-clusters, one corresponding to the ammonium parameter and a second one that includes the nitrites and, much closer, the conductivity, chlorides and sodium parameters. The third cluster (CL3) groups total phosphorus, dissolved organic carbon and total soluble nitrogen parameters. The next cluster (CL4) is associated only with fluorides. The cluster number 5 (CL5) includes the oil and grease parameter and, with lower distance (higher correlation), the chemical oxygen demand, the biochemical oxygen demand, the total suspended solids and the volatile suspended solids. The dendrogram presents further 2 clusters, CL6 with pH parameter only and CL7 which includes the sulphates, the nitrates and the phosphates parameters. This way, the parameters with similar pollution source and, thus, corresponding to redundant measurements, are now grouped in the same cluster. As 7 main cluster were found, in principle, to obtain a correct, faster and cheaper characterization of fish canning industry wastewaters, it is necessary to analyze only 7 main parameters, instead of the 19 original ones, in order to be possible to define the most adequate treatment process for this type of wastewater.