ELABORATION OF CERAMIC MATERIAL WITH SLUDGE FROM THE WASTEWATER TREATMENT PLANT OF THE TOMATO PROCESSING INDUSTRY

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INTRODUCTION

The tomato processing industry generates huge quantities of sludge annually, (1.5% of the tomato) which represents an environmental problem, especially in the large producing areas such as Extremadura in Spain.

The substitution of clayey raw materials for other wastes, in this case tomato sewage sludge, in the production of traditional ceramics, could be cost effective from the utilization and recycling of these wastes as a secondary raw material.

Different quantities of sewage sludge from the tomato processing industry have been added to the body of the clay to produce ceramic materials. It has achieved a ceramic material with greater porosity to improve its thermal and acoustic insulation capacity.

Key words: tomato industry, sewage sludge, clay, building material.

MATERIALS & METHODS

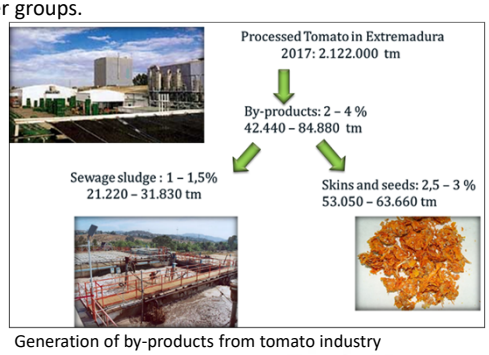
The replacement of part of the clay raw materials by sludge from wastewater treatment plants of the tomato industries can lead to a saving in the cost of raw material due to the use of a secondary raw material and can help, at the same time, to solve a serious environmental issue due to the massive storage of this type of waste.

The first step of this study began with the physical chemical analysis and valorization of the sludge coming from the wastewater treatment of the tomato industry that has a seasonal activity (which is given away or destroyed due to lack of viable uses) and the. The second step was to air condition by solar drying the sludge in air by solar drying to stabilized it and to avoid bad odor and further reactions of fermentations.

Finally, the waste already characterized, was used to develop different prototypes, in which the clay material has been substituted by sludge from the tomato industry in different proportions (0, 3, 6, 9 % mud). The ceramic pieces finished were submitted to a series of tests directed to determine the physical characteristics of the new bricks and to know their mechanical behavior, so that they fulfill the current legal regulation. They were subjected to: Linear Cooking Contraction, Suction Tests, Flex Resistance, Absorption and Surface Color analyses.

RESULTS & DISCUSSION

The Extremadura tomato is produced by more than 1,200 farmers in 23 Producer Groups, which produce it in 14 industries spread between the Las Vegas del Guadiana and the Alagón-Árrago region and are integrated into 23 producer groups.

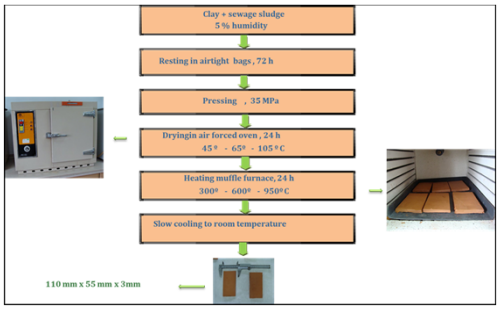


Generation of by-products from tomato industry Extremadura, Spain 2017

Parameter	Humidity (%)	pH	Organic material (%)	Nitrogen (%)	Phosphorous (mg/kg)	Copper (mg/kg)	Lead (mg/kg)	Iron (mg/kg)	Nickel (mg/kg)	Cadmium (mg/kg)
Value	59,68	7,23	7,43	0,2	935,61	12,22	4,09	969	1998,5	<10

Table 1. Physical – chemical analysis of sludge

Clay specimens were prepared with different amounts of sludge: 0, 3, 6 and 9 % by weight to study which is the most suitable percentage to the desirable characteristics in the finished pieces. 30 prismatic bricks were elaborated with a mold of 110 mm x 55 mm x 3 mm, at a pressure of 35 MPa, according to the industrial process.



Subsequent steps for the elaboration of bricks

A comparative quality control of the new ceramic material with the standard clay-based material have been done, following the next analytical procedures: Linear Shrinkage, Suction, Flexural Strength and Surface color.

Considering that the trial has been developed at laboratory scale, the values can be considered as promising for the future industrial manufacturing.

A clear relation of the coefficient of Linear Shrinkage with respect to the sludge/clay mixture applied is not observed. The water Suction increases as the percentage of sludge applied to the mixture increases. The variation is 15% between the control specimen and the maximum percentage of sludge applied. The Flexural Strength of the material decreases as the percentage of sludge in the mixture increases. The decrease in Resistance is 31% between the test specimen and the specimen with more percentage of sludge. The Color does not vary significantly once the material has been cooked.

CONCLUSIONS

The regulations required to choose the most appropriate mud/clay mixture must be considered. (UE) Nº 305/2011

If these experiences were carried out at industrial level and commercialization were achieved, the two sectors involved could benefit:

- Tomato processing industries will reach a reduction of economic expense in waste management. To get a profit for its sale.
- Manufacturers of cooked clay for building will buy an economical raw material to obtain a more economical final product and increase product range.

Success with the study would contribute to the respect European Directives, 2.12.2015 COM (2015) about Action Plan for a Circular Economy in Europe.

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