THE USE OF REOLOGICAL FOOD CONTROL METHODS TO MINIMIZE THE INFLUENCE OF RESIDUES FROM THE STARCH INDUSTRY IN WATER POLLUTION

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Keywords: starch, thixotropic fluids, rheology, mechanism

ABSTRACT

The paper is part of a complex study that uses of thixotropic fluids properties to eliminate the risks of pollution of groundwater with compounds from the food industry.

This paper concentrates a study during three years (2015-2017) regarding the increase of the pollution received water, effect of the increased toxicity in the waste water from starch factory.

For quantification of results on studying the principal physical-chemicals parameters for this water and report to the same standard parameters for distinguish pollution received water.

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INTRODUCTION

Starch is in better quality range if it is obtained from starchy plants (potatoes, corn, cereals) that are grown under specific conditions of organic farming (Bonciu E., 2014).

Another advantage is the price of this organic food (used as thickening agent in various combinations) - which is higher than a conventional product. The use of raw materials from organic farming systems can eliminate certain contamination conditions and greatly help to separate the concentration of quality starch (Bonciu E., 2015).

There are also no-tillage modern technologies that can lead to starchy plants with good yield and lower prices (Dobre M, 2015).

For growers of these starchy plants, knowing of eco-pedological practices is essential in obtaining the high value added foods that can be used both in current nutrition and in the prevention or control of certain diseases (Popescu C., 2008).

The waste waters can act with a greatest importance in to human and animal's life domain, and for this reason it has studied carefully the increased pollution as a result of increased sewage pollution from starch industry (Banu C-tin, 1998).

Often, the food producers act to obtain the foods on good ratio price/quality and good transformation yield and the important aspects of sewage sludge from starch factories are ignored (Kreipe, H., 1989).

In the manufacture of starch - from potatoes or corn – can be produced large quantities of wastewater (20-25 m^3/t product), with suspensions 1000-4000mg/dm^3 with generally acid *p*H and oxygen biochemical consumption between 3000 - 4000 mg/dm^3 (Leonte M., Florea T., 1998).

They can cause major environmental disturbances, through the major toxicological changes or hazardous environmental accidents (Chiriac,V., 1987).

Therefore one of the most important directions of development of European Union Drafts include the promotion of new and clean technologies and monitoring of water from the food industry and other industries with high risk contaminant potential.

Another important aspect in this area of food production - included in the European Union's long-term sustainable development strategy - is the reduction of food waste, the recovery and re-use of some by-products of the technological chain (Savescu P, Popa A., Popa Daniela, Cristina Banta, 2005).

Starch is a polysaccharide that tests at certain temperatures and pressures thixotropic properties (Belitz E., Grosch M., Schieberle P., 2009). Thixotropic fluids are fluids that show a shear thinning property. Certain gels or fluids that are thick (viscous) under static conditions will flow (become thin, less viscous) over time when shaken, agitated, or otherwise stressed. They then take a fixed time to return to a more viscous state (Florea T., 2001). In the case of rheopatic fluids, the structure build as shearing continues. Rheopectic behavior may be described as time-dependent dilatants behavior. This type of behavior is much less common but can occur in highly concentrated starch solutions over long periods of time.

Some thixotropic fluids return to a gel state almost instantly, such as starch solution, and are called rheological fluids (non-Newtonian fluids that is time dependent). Others such as emulsion water in oil take much longer and can become nearly solid. Many gels and colloids are thixotropic materials, exhibiting a stable form at rest but becoming fluid when agitated.

MATERIALS AND METHODS

In an extensive program of monitoring the waste water from food industries that was developed over a period of three years (2005-2007) were studied the changes of main physical-chemical parameters of wastewater from a factory starch production in Southern of Romania.

In this draft, have been monitored the Variability of *p*H, conductivity, alkalinity, fixed residue, total hardness, CCOMn, BOD_5 and concentration of chloride, nitrates, nitrites, sulfates, phosphates, ammonium – all the results were comparing with the maximum allowable values for STANDARD water from the food industry.

For Analysis were used Ion-meters for laboratory type 3205 and type 3345 and specific kits for ever compounds.

Samples met all the conditions of repeatability and were differentiated, as appropriate (normal operation of the plant, abnormal operating conditions, and stop accidental or planned revisions).

For correct results were previously separate all substances that could interfere in the analysis.

For starch solution was use the Brabender Micro Visco-Amylo-Graph that can measures temperature-dependent and time-dependent viscosity properties, especially of flours, starches and other derivate materials. This equipment use 110 mL sample volume, heating/cool rates 0.5-10^{O} C/min, at 0-300min^{-1} speed and is better for this scope.

The instrument is equipped with an integrated, self-optimizing temperature control unit which, together with the comfortable software, permits easy programming and running of any temperature profile. The paddle, which completely immerges into the sample, is connected to a high-resolution torque sensor for precise viscosity determination. The special geometry of the paddle ensures good mixing of the sample – there is no sedimentation of starch particles. Temperature measurement is done directly in the sample. This makes it easy to always precisely assign the temperature to the current viscosity. Test conditions and temperature profiles can be stored and recalled at any time for a new test. Beside the standard evaluation with peak viscosity, the evaluation profiles can easily be programmed and used.

Support the reproducibility and accuracy of your measurements by using the F12-EH Refrigerated/Heating Circulator.

RESEARCH RESULTS

The waste water tends acid fermentation, promoting the rapid development of fungi, consuming faster the solved oxygen in to the receiver water, allowing the anaerobic decomposition phenomena with formation a sulfhydric acid.

Following the determinations were obtained the results from Table 1.1. and 1.2.

Table 1.1.

The main physical-chemical items calculate of wastewater from the starch factory (averages values from 2015-2017)

	*p*H (unit for *p*H)	Conduc-tivity (µS/cm)	Fixed residue (mg/L)	CCOMn (mg/L)	Total Hard-ness (º G)	Alkalinity (mE/L)
The obtained average values	5.18	1432	786	1624	15.2	COLOUR.
The maximum allowable values (STAS 4706-74)	7.2	1640	2000	40	15	4.5

From this results it can be observed major exceeded for chemical consumption of oxygen (measured through $KMnO_4$ method), an increased of acidity of the environmental and an increased of turbidity and color for the wastewater.

Table 1.2.

The variation of mean ion concentration determined in to wastewater from the starch factory (averages values from 2015-2017)

	CHLO-RIDES (mg/L)	NITRI-TES (mg/L)	NITRA-TES (mg/L)	SULFA-TES (mg/L)	PHOSPHA-TES (mg/L)	AMMONIUM (mg/L)
The obtain-ned average values	224	0.638	58	246	1.824	24.8
The ma-ximum allowa-ble values (STAS 4706-74)	60	1	25	70	4	2

The increased of acidity in to wastewater can be provided by the greatest content of chlorides, sulfates and the great increased of ammonium and nitrates concentration can determined the abnormally color of waste water.

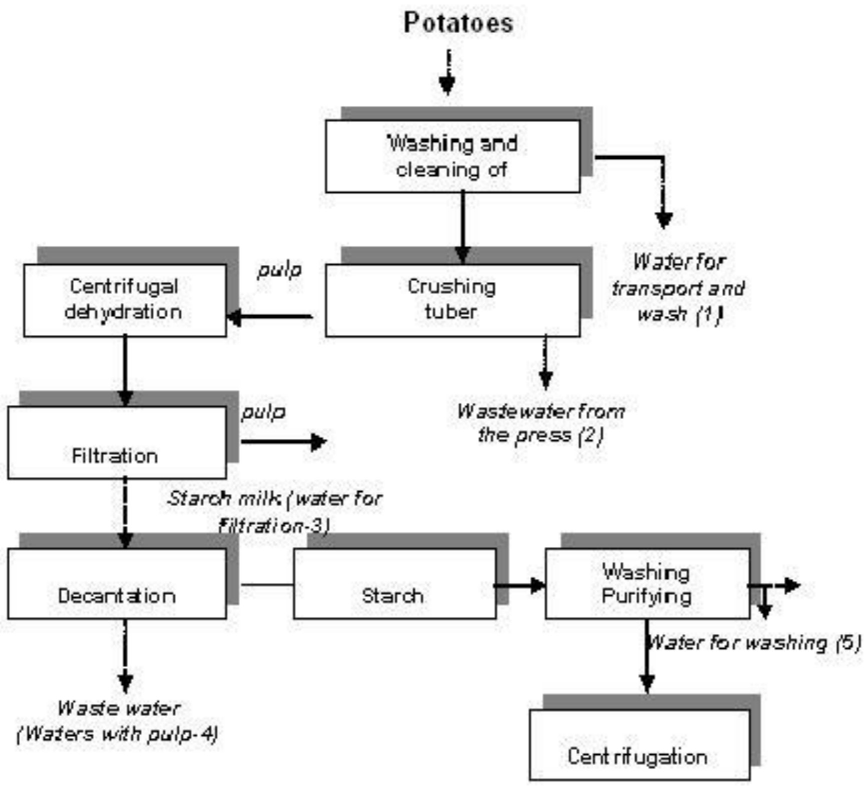

Fig.1. Scheme of starch production process (the main source of wastewater)

Apart from sand, raw and earth materials (5-20% by weight of tubers), water for washings (1) containing small pieces of potato and to a certain extent elements in solution.

The wastewater with pulp (3 and 4) contain large amounts of organic matter, that can fermented and rot in dissolved state or not, and small amounts of minerals (especially K and P compounds), each characterized by a tendency for fermentation the secondary products and can formation of lactic acid and butyric acid, butyric cleared through its combination of a series of odors, that can changing negative sensorial qualities of the receiving waters.

The used water for washing the starch (4) contains a large dilution of soluble elements of tuber or maize and less starch granules or pulp.

The wastewater from (2) are similar to (3), except that nitrogen –in to albumin form - is present here (0.3 kg N / tone of processed potatoes).

An effective and efficient management must include getting the optimal report price/ product quality and the pollution standard’s agreement for the environment too.

The product’s custom satisfaction will be complete, in the clean, ecological environment keeping conditions.

The use of thixotropic properties of starch can increase the quality of wastewater and can lead to starch-separation (an increase of 4.25 times the amount of starch recovered from the total amount of residual water using a complete system of specific decanters) (Savescu P., Banta Cristina, 2005). This recovered starch can be reused in other industries (thickening agent in the acid dairy industry) and thus greatly diminish the risk of eutrophication of the environment and waste the food resources.

CONCLUSIONS

Due to the significant volume and loading them is not advisable to evacuate the wastewater from starch factories in urban drains without prior their treatment in to especially fermentation tanks or with activated sludge for conduct to a convenient value;

In plants of starch is possible the recirculation for washing water for starch as a very advanced recovery of substances;

The wastewater from the starch industry may cause significant increases in receiving waters for the concentration of organic matter and dissolved oxygen, the BOD_5, germs, including the number of cols (an increase of about 8 to 18 times), but using modern technology, through the advanced hydro-separators performance leads to improved extraction efficiency but also to more advanced water purification;

When using sulfuric acid to soak corn, it must be neutralized even shipped with lime, sodium carbonate and calcium sulfate, the best curves of sediment for wastewaters, raw, from manufacturing of starch achieving a dose of 900 mg CaO /L (compared to the current 300-1200 mg CaO/L)

The use of thixotropic properties of starch can increase the quality of wastewater and can lead to starch-separation.

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