

A SEMI-PILOT PLANT FERMENTER FOR THE PRODUCTION OF COAGULANT -AIDS FROM DIARY PRODUCTS WASTE WATER

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Abstract :

dried suspension of the extracellular materials (DSEM) from batch fermented dairy product wastewater, that acted as a coagulant-aids, for raw water treatment was produced in a massive quantity using fermenter designed on the following specification; 55 liter (dairy products wastewater, plus 25mg/l of molasses); Mixing speed, pH, growth temperature, and fermentation time were, 1490rpm, 6.8, 28 C, and 120h respectively.

At the end of fermentation time the yield of DSEM was 75.3gm (i.e. the dry weight of extracellular materials suspension). When 28mg/l of DSEM was added to the raw water, the alum-floc sizes increased four-folds. The sedimentation time reduced by 31.6% and the increased in turbidity reduction was 41.1%.

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Introduction

It has been reported that the bacterial extracellular polymers extracted from aquatic environments composed mainly of polysaccharide nature (Hejzlar and Chudoba,1986). Microbial polysaccharide have a wide range of industrial application (Paul, et al., 1986) among these, their application as natural coagulant-aids for improvement of water treatment (Gulas, et al., 1979).

The aim of the present work is to apply natural bacteria, found in the dairy products wastewater, for the production of bacterial extracellular materials, produced from a devised semi-pilot plant fermenter, and to apply a such material as a coagulant-aids for raw water treatment.

Experimental Procedure

Fermenter design:

The design of the fermenter is illustrated in diagram 1.

Sample collection:

Sixty-liters of the samples were collected from the final discharge point of the General Enterprise of Dairy Product Factory, Baghdad. Samples were kept in icebox during transportation to the laboratory. The time between sample collection and analysis never exceeded two hours.

Sample fermentation:

Fifty-five liters of wastewater samples were loaded in to the fermenter vessel.

Twenty-five milligrams per liter (at a density of 1.5gm/l) of molasses (obtained from Emara Sugar Factory-Iraq) were then added, followed by the adjustment of the pH at 6.8.

The following variables were fixed, before the fermentation run beginning: Temperature, 28 C; pH, 6.8; mixing speed, 1490 rpm, and fermentation time; 120h,. Hydrochloric acid and sodium hydroxide (1N), were used for pH adjustment.

Preparation of dried suspension extracellular material (DSEM) :

At the end of fermentation period, the solid phase was separated from the liquid phase by centrifugation at 3000g, using a Heraeus Christ-labofuge GL centrifuge; at room temperature (22-26 C) . the precipitate was discarded, while the clear centrifugate (that contain DSEM) was dried at 60 C to give 7.3gm dry weight.

Application of DSEM (as a coagulant -aids) for raw water treatment:

A range doses of DSEM were added to the raw water, collected from Tigris river (having a turbidity of 37NTU) , plus the constant normal dose, i.e. 20mg/l, of alum ($Al_2(SO_4)_3 \cdot 18 H_2O$).

A set containing different concentrations of DSEM was prepared. Sedimentation time and turbidity were considered as a parameters for judging the Efficiency of water treatment performance. These two variables (i.e. sedimentation Time and

turbidity) were measured according to the method described by APHA (1975), at room temperature.

For comparison, a set of control was prepared. It contained the same constituents of test samples excluded DSEM.

Results and Discussion;

The results of the present work showed that the yield of DSEM was 75.3gm dry weight. This quantity obtained from the fermentation of 55 liters of dairy product wastewaters. The optimal dose of DSEM to give most efficient raw water treatment was 28mg/L. This quantity showed the development of the biggest floc sizes range (i.e.225-303 μ). The lowest sedimentation time (i.e. 17.0 minutes) and the lowest value of turbidity (i.e. 7.8NTU) respectively (table 1). At the other DSEM concentrations, the efficiency was less when , for example, high (i.e. 50mg/l) or low (i.e. 10mg/l) doses were applied.

The present work shows that the settling properties have improved due to the development of flocs that have bigger sizes. This may explain the reduction in both; sedimentation time and turbidity, in comparison with the application of alum alone (table 1).

It is known that capital expenditure in the production of coagulant-aid to improve water treatment is expensive today. The method used in the present study, for production of DSEM (as coagulant-aids), might be economic. This is because the material substrate used was waste material. However, other running costs and capital costs of fermenter have to be taken into consideration.

The work reported in this study needs to be extended in the field of physico-chemical characteristics, e.g. molecular weight charge density, and the chemical structure of the polymer, beside application of pure (instead of mixed) culture of bacteria. More work is also required to investigate the toxicity of such additives, on short and long-term dosing, and the production of such materials in massive quantities, before field application.

Acknowledgement

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TABLE 1. Average floc sizes, sedimentation time, and turbidity of The Tigris River waters, under different methods of treatment.

| Method of treatment | Average floc sizes (μ) | Sedimentation time (min) | Turbidity (NTU) |
|---|------------------------------|--------------------------|-----------------|
| Addition of alum 20 mg/L (control) | 22-87 | 25 | 11.4 |
| Addition of alum and 28 mg/L DSEM | 225-303 | 17 | 7.8 |
| Floc size increasing | 4-folds | | |
| Percentage of sedimentation time reduction | | 41.1 | |
| * Increase in the percentage of the turbidity reduction | | | 31.6 |

(*) The calculation is based on the turbidity of raw water of The Tigris River, before any treatment (i.e.37NTU).

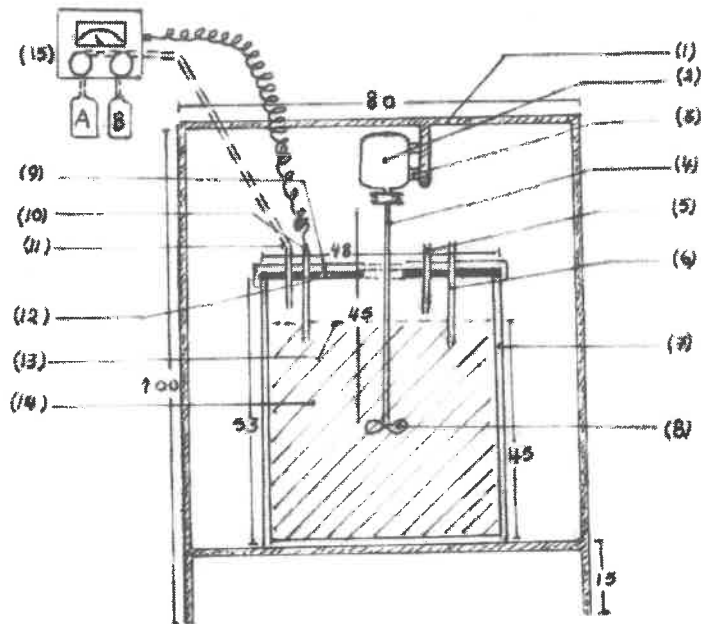


Diagram 1. Fermenter design

- 1 Holder
- 2 Electric motor (1.5A 0.12Kw, 1490 rpm)
- 3 Rubber (Dim. 10mm, H. 30 mm)
- 4 Metal rod (13 mm)
- 5 Hole for thermometer fixing (Dim. 10mm)
- 6 Hole for sample collection
- 7 Plastic container.
- 8 Mixer
- 9 Container (7) cover.
- 10 Hole for pH electrode fixing (Dim. 13 mm).
- 11 Hole for pH adjustment (Dim. 10mm)
- 12 Rubber washer (thickness 9mm)
- 13 Liquid (14) level.
- 14 Reaction substrate
- 15 pH -meter controller

A= Acid, B= Base

Scale (cm)= 1/ 71.42

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مفاعل حيوي شبه حلقي لإنتاج مساعدات تخثير من المخلفات السائلة لصناعة الألبان

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خلاصة:

العالق الجفف للمكونات الخارج خلوية (DSEM) ، الناتج من تخمير (ونظام الدفعة) المخلفات السائلة لصناعة الألبان ، استخدم كمساعدات تخثير لمعالجة المياه الخام ، حيث أنتج هذا العالق وبكميات كبيرة وذلك باستخدام مفاعل حيوي (تخمر) صمم طبقا للمواصفات التالية:-

السعة : ٥٥ لتر (من مياه صرف صناعات الألبان مضاف اليه ٢٥ ملجم / لتر من المولاس).

سرعة الخلط : ١٤٩٠ دوره / الدقيقة.

درجة pH : ٦,٨ .

درجة حرارة التحضين : ٢٨ م.

فترة التحضين : ١٢٠ ساعة.

في نهاية فترة التخمير كان حاصل الـ (DSEM) ٧٥,٣ غم (وهذا يشكل الوزن الجاف للمكونات الخارج خلوية) .

عند إضافة ٢٨ ملجم / لتر من الـ (DSEM) إلى المياه الخام (الغير معالجة) ، وبالمقارنة مع العينات القياسية ، أشارت النتائج إلى وجود زيادة ، وبمقدار أربعة أضعاف ، في حجم لبادات الألمنيوم وإن فترة ترسيب هذه اللبادات انخفضت بمقدار ٣١,٦ % ولوحظ أيضا زيادة في انخفاض درجة العكورة وبمقدار ٤١,١ %

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الخلاصات (Abstract)