

Supplementary Materials: Effect of Microwave Radiation on Regeneration of a Granulated Micelle-Clay Complex after Adsorption of Bacteria

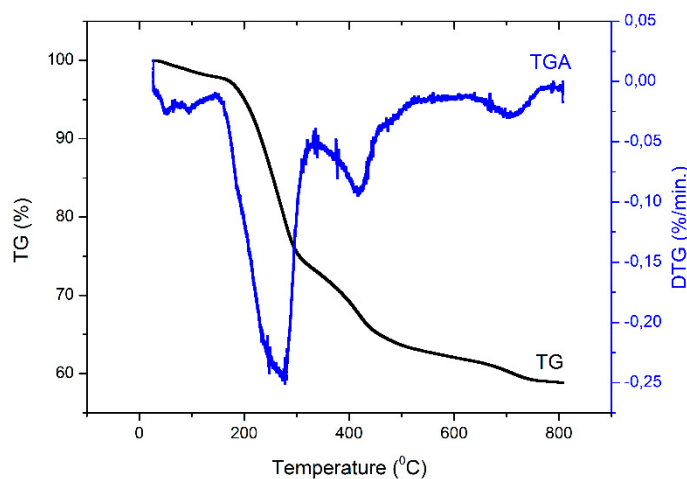
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1. Granulation Procedure

Granulated complexes of ODTMA- and BDMHDA- clay were prepared as described (1). Briefly, the amounts used were multiples of 10 g/L clay and 12 mM of the salt of the cation. The stages of preparation were: 1. Incubation of the (salt of) organic cation in tap water at a temperature between 38 °C and 50 °C followed by addition of the clay. 2. Removal of water in a membrane filter press to a final water content of about 50%. The cake produced was put in an oven at a temperature of 60 °C to reach a humidity between 42% and 45%. 3. Granulation of the cake was accomplished by a two-stage machine, a shredder to obtain the desired granule size followed by spherodizing to produce spherical granules. 4. Drying of the granular micelle-clay complex in an oven at 60 °C to 3% humidity. 5. Sieving the granules to diameter sizes between 0.3 and 2 mm.

2. Thermogravimetric analysis (TGA) of BDMHDA-Clay

The thermogravimetric analysis (TGA) of BDMHDA-clay samples is presented in Figures S1a and S1b, which can be compared with those of ODTMA-clay in Figures 5a and 5b. First, the thermoanalytical step (<150 °C) is related to the mass loss of adsorbed water and gaseous species. The mass loss observed in the ODTMA-clay sample as a result of heating processes is lower than in the sample of BDMHDA-clay. The initial decomposition temperature of ODTMA is 272 °C for a MW free sample; in MW heated samples, this temperature decreased to 264 °C. For BDMHDA-clay samples, initial decomposition temperature was shifted from 274 °C (MW free) to 244 °C (MW heated).



(a)

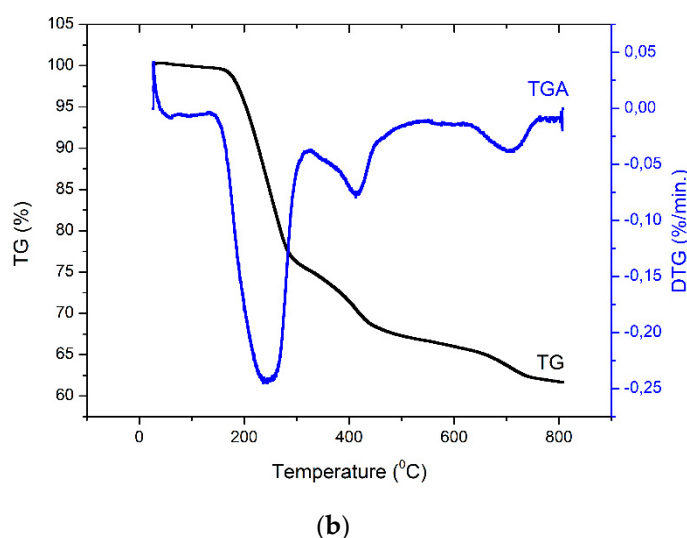


Figure S1. (a) Thermogravimetric analysis of BDMHDA-clay samples, no MW; (b) Thermogravimetric analysis of BDMHDA-clay samples with MW treatment.

Below are several additional filtration experiments. The experiment shown in Table S1 was performed in March 2019. The average filter capacity for this experiment was 4.5 liters per gram. The estimated relative errors in the number of bacteria were less than 10%.

Table S1. Removal of total bacteria count by fresh micelle-clay granulated complex by filtration (CFU per mL)*.

Source of Sample	30.7 (L)	143.1 (L)
TAP	210	210
1	< 1	2
2	< 1	2
3	< 1	5
4	< 1	< 1

* TAP refers to continuous tap water inlet. The numbers represent the column filters from the experiment. Columns 2 and 3 (rows 2–5) indicate the numbers of emerging bacteria. The average flow rate for this experiment was 7 ml/min for each column.

The experiment shown in Table S2 was performed in December 2019. Twenty days after stopping the filtration, it was resumed once again for 1 day under the same experimental conditions. The columns and tubes did not go through any type of disinfection, in order to simulate a home filter that accumulates bacteria. The accumulated volume that passed through the filters was 129.6 L.

The regeneration process was performed by heating the used granules in the MW oven for several periods starting with 30 seconds, and when the weight exceeded the original value by 5%, the samples were heated in durations of 20 s.

Table S2. Removal efficiency of total bacteria count by ODTMA–clay fresh granules: filtration of 8.6 L after stopping for 20 days followed by filtration after MW regeneration (CFU per mL).

Source of sample	8.6 (L)	17.3 (L)
TAP	6	2
Container	110 ^d	1
1	190 ^c	8
2	8	2
3	16,000 ^a	40 ^d
4	460 ^c	15
5	1,300 ^b	5
6	67,000 ^a	100 ^d

* Tap and Container refer to continuous tap and container water inlets, respectively. The estimated relative errors in the number of bacteria were 50%, 40%, 30%, and 20%, in cases denoted by a, b, c, and d, respectively; in other cases, they were less than 10%.

The total volume that previously passed through each column filter was 121 L, which corresponds to a capacity of 3.8 liters per gram of granulated complex after the columns were saturated with water. The average flow rate for the filtration process using fresh granules was 6 ml/min for each column filter.

The experiment shown in Table S3 gives results after third regeneration, which proceeded for two days from October 21, 2019.

The average flow rate for the third regeneration (Table S3) was 6 ml/min for each column filter. The total volume that passed through each column filter was 17.2 L. The capacity estimated was 0.5 liters per gram of complex. After the first day all samples included a small number of emerging TBC, whereas after the second day, three samples yielded acceptable values.

Table S3. Removal efficiency of TBC by ODTMA granules after third regeneration (CFU per mL): number of emerging bacteria after filtration of given volumes *.

Source of Sample	8.6 (L)	17.2 (L)
TAP	390 ^b	140 ^c
Container	140 ^c	110 ^c
1	60 ^c	3700 ^a
2	6	100 ^c
3	50 ^c	540 ^b
4	5	50 ^c

* Columns 2 and 3 in the Table indicate the filtered volumes. The third regeneration was performed by MW heating. The estimated relative errors in the number of bacteria in cases a, b, and c are 40%, 30%, and 20%, respectively; in other cases, they were less than 10%.