Financováno Evropskou unií NextGenerationEU
NÁRODNÍ PLÁN OBNOVY
Ministerstvo životního prostředí
STÁTNÍ FOND ŽIVOTNÍHO PROSTŘEDÍ ČESKÉ REPUBLIKY
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Tento projekt je financován Evropskou unií v rámci Národního plánu obnovy.

Tool: Games with sewage sludge

We have prepared an illustrative tool for you that will allow you to examine the behavior of sewage sludge in two situations - in the presence of detergent and dye. The effort is to illustrate the importance of sewage sludge, which actively eliminates pollutants through physical adsorption and microbial degradation (biodegradation).

I) DETERGENT

Time:	Environment:
15-30 minutes	anywhere, ideally a table

Equipment and materials needed:

- 2x 1000 ml cylinder (tall)
- 400 ml beaker
- a teaspoon
- battery motor with 2 tubes
- syringe
- plastic tray/tray
- Spring
- 200 ml of activated sludge
- 800 ml water (tepid)

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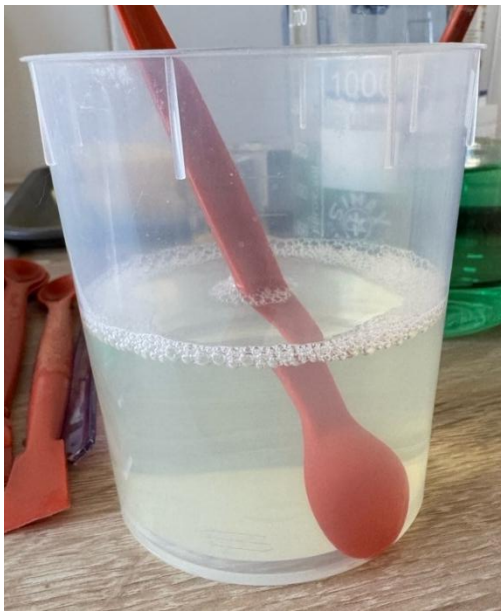
Procedure:

1) First, we prepare the spring solution. Put 1 teaspoon of spring into a 400 ml beaker and slowly pour 200 ml of water down the wall. Stir the solution slowly.
   ATTENTION! The addition of water and mixing must be really slow, as we do not want the solution to form too many bubbles.
2) Add 200 ml of sludge to the first 1000 ml cylinder and add 200 ml of water. Put 400 ml of water into the second 1000 ml cylinder.
3) Place the cylinders on a plastic tray to prevent spillage. We add tubes to both cylinders and turn on the aerator.
4) We start the experiment by adding 1 ml of our spring solution to both cylinders and let it bubble for a while.
   We observe how foam is formed in both cylinders, but it is more intense in the water itself.
5) Gradually add 0.2 ml of spring solution to both cylinders and observe what happens. We repeat the addition of 0.2 ml 2 more times (that is, we add a total of 1 ml + 0.2 ml + 0.2 ml + 0.2 ml of solution to one cylinder).
   After further additions, we observe intense formation of foam with the water itself, but gradually we also observe more foam with the cylinder with sludge. The capacity and ability to process sludge jar is beginning to be planned.
6) We'll let everything bubble for as long as we need, in the meantime we can comment on what's going on.
7) Then we turn off the aerators, let the overloaded sludge settle, and we can come back to it later and show how it regenerated.

What we observe:

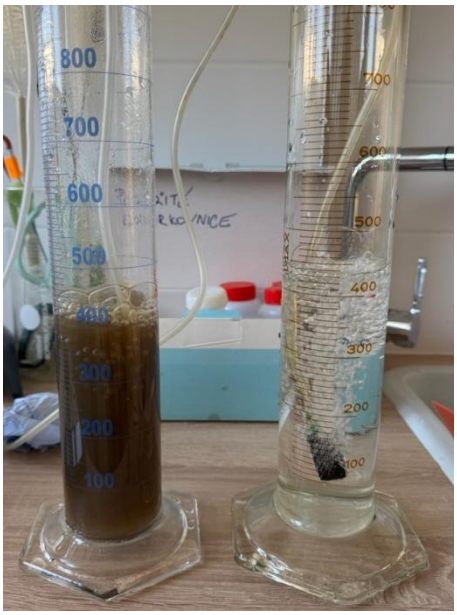
During the experiment, we can observe that in the cylinder with sludge, not so many bubbles are formed and at the same time they disappear faster than in the cylinder with only water. This occurs due to the adsorption of surface-active substances on sludge particles and their biodegradation by microorganisms.

1) Prepared spring solution.

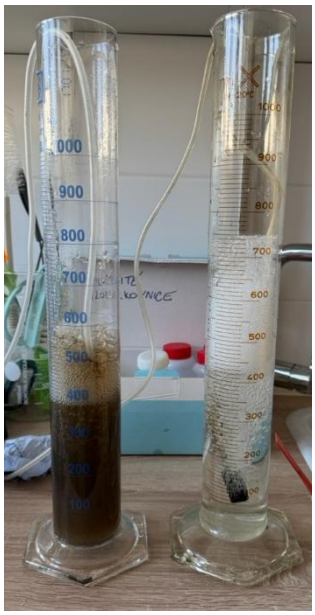


2) Metering cylinders before aeration.

3) Metering cylinders during aeration.



4) Addition of 1 ml of spring solution.



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5) After the third addition of 0.2 ml of spring solution.

6) End of the experiment.

II) DYE

Time:	Environment:
15-30 minutes	anywhere, ideally a table

Equipment and materials needed:

- 2x 1000 ml cylinder (tall)
- 400 ml beaker
- a teaspoon
- battery motor with 2 tubes
- plastic tray/tray
- turmeric (powdered spice)
- 200 ml of activated sludge
- 800 ml WARM water

Procedure:

1) First, we prepare a turmeric solution. Put 2 teaspoons of turmeric in a 400 ml beaker and add 200 ml of warm water. Stir the solution slowly.
   Turmeric is hydrophobic, so it will stay on the surface. It needs to be mixed before pouring into the cylinders.
2) Add 200 ml of sludge to the first 1000 ml cylinder and add 200 ml of warm water. Put 400 ml of warm water into the second 1000 ml cylinder.
3) Place the cylinders on a plastic tray to prevent spillage. We add tubes to both cylinders and turn on the aerator.
4) We will start the experiment by adding 200 ml of our turmeric solution to both cylinders and letting it aerate for a while (about 5 minutes, maybe even 10 minutes). Here we can fill the time by talking about what is happening and what we want to observe.
   We observe how a little foam is formed in both cylinders.
5) We turn off the aeration, we can also remove the tubes. Let it settle and monitor the result.
   Thanks to the warm water, sedimentation should take place immediately. With cold water, the sedimentation would not be as intense and it would take an unnecessarily long time.

What we observe:

During the experiment, we can observe that the bright yellow color in the sludge cylinder gradually fades. This occurs due to adsorption onto sludge particles and biodegradation by microorganisms. Conversely, a cylinder with only water is deep orange and the undissolved remains of turmeric settle to the bottom.

1) Prepared turmeric solution.

2) Condition before aeration and dye application.

3) Condition during aeration.

4) Sedimentation.

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Checklist:

- ☐ Box with lid
- ☐ 4x 1000 ml cylinder
- ☐ 2x 500 ml beaker
- ☐ 2x spatula/spoon
- ☐ 10x syringe
- ☐ 2x plastic shallow box
- ☐ 4x battery motor
- ☐ 24 AA batteries
- ☐ Black extension cord (5 sockets, 5 m)
- ☐ LED light
- ☐ Jar (1.35 L)
- ☐ 2x bags with turmeric

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