STUDY OF CONSECUTIVE RESUSPENSION AND SEDIMENTATION PROCESSES IN AQUACULTURAL BIOSOLIDS USING AN OSCILLATING GRID

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Introduction

In aquacultural tanks, biosolids are present in the water column and/or tank bottom. Their presence at bottom can lead to hypoxic conditions that affect fish welfare and growth. On the other hand, if biosolids are maintained in the water column, they are susceptible to be removed from rearing areas. Biosolids maintenance in the column depends on the turbulence present in the tank, which will depend on the culture conditions (fish swimming activity) and tank design (geometry and water inlet conditions). The turbulence needed to resuspend biosolids in the water column has been analysed by Masaló et al (2005, 2006) using an oscillating grid.

In this study we use an oscillating grid to determine, after the resuspension of biosolids, the turbulence level needed to maintain them in the water column. The relationship between turbulence and percent of biosolids in water column are compared along the resuspension and sedimentation process.

Materials and methods

The device used to relate the root mean square of the turbulent velocity (*RMS*) with the oscillation of a mesh in a fluid was an oscillating grid, which allows to relate *RMS* with oscillating amplitude (stroke *S*), frequency of oscillation (*f*), and distance (*z*) between the mesh and the bottom (Hopfinger and Toly, 1976; Masaló et al, 2005).

Two trials were made, one studying the resuspension process (Resuspension Trial) and another one studying the sedimentation process (Sedimentation Trial). For each trial, biosolids were collected from two different tanks containing Sea bass (*Dicentrarchus labrax*, L.). Collection was made through the outlet pipe situated in the false floor at the bottom of the fish tank, and the biosolids collected were placed in grid containers. After their deposition in the bottom, grid movement was started and *RMS* were increased gradually every 20min (Resuspension trial). With each *RMS* level, a 5ml water sample was taken out from the container to determine biosolids concentration. After total resuspension of biosolids, Sedimentation Trial was started, decreasing *RMS* gradually every 30min, and water samples were taken out at each *RMS*, in the same way as in Resuspension Trial.

Concentration of biosolids in water samples was indirectly estimated from the turbidity measures made with a spectrophotometer (Hach, model DR/2000). The relationship between turbidity and Total Organic Carbonic (TOC) was determined in some samples, measuring TOC with an Analyser (Shimadzu, model TOC-V_{CSN}), connected to a Solid Sample Module (Shimadzu, Model SSM-5000A).

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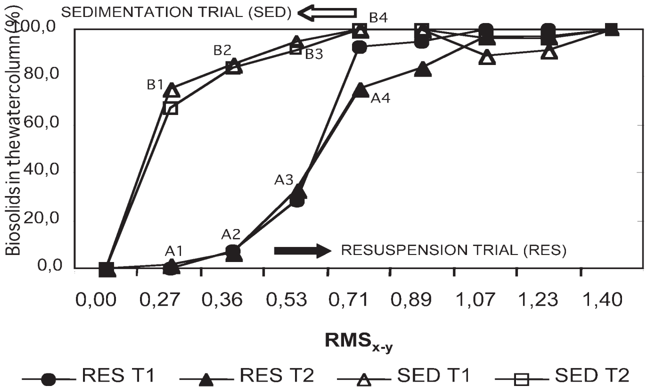

Figure 1: Percentage of biosolids in the column during Resuspension (filled symbols) and Sedimentation Trial (non-filled symbols). SED T1 and SED T2: Biosolids from tank 1 and 2, respectively.

Results and Discussion

The relationship obtained between TOC and turbidity was strongly lineal, showing the turbidity as a good indirect measurement of the biosolids concentration.

As we can see in figure 1, the *RMS* needed to resuspend a fixed percent of biosolids from the tank bottom is substantially higher than the *RMS* needed to maintain the same percentage suspended in the water column. In our case, to resuspend a 75% of biosolids, we need a *RMS* close to 0.8cm s^{-1}. Nevertheless, an *RMS* 0.3cm s^{-1} is enough to maintain the same amount of biosolids (75%) suspended in the water column. In the same way, we can see that an *RMS* 0.45cms^{-1} allows to maintain 85% of biosolids suspended, but is only capable to resuspend 10% of biosolids settled in the tank bottom. For both samples of biosolids (from tank 1 and 2), its percentage in the water column vs. *RMS* showed a great dependence on the initial state, resulting in loop classified as a counterclockwise (hystieresis). In this study the minimum *RMS* that allows to maintain all the biosolids in the column after their resuspension would be around 0.71cm s^{-1}, and the *RMS* needed to resuspend all the biosolids would be higher than 1cm s^{-1}.

The comparison of these values with the turbulence generated by inflow water and fish swimming activity (Oca *et al*, 2005), will be very useful to predict the existence of self cleaning conditions in the tank or the accumulation of biosolids in the tank bottom.