# IMPROVING THE OSCILLATING GRID METHOD TO CHARACTERIZE AQUACULTURE BIOSOLIDS USING A LASER BEAM AND IMAGE ANALYSIS

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Quick removal of biosolids in aquaculture facilities, and specially in recirculating aquaculture systems (RAS), is one of the most important step in waste management. Sedimentation dynamics of biosolids in an aquaculture tank will determine their accumulation at the bottom of the tank. If biosolids left undisturbed the resistance to resuspension increases, and leaching can take place, increasing the dissolved organic waste and complicating their management.

Masaló et al. (2008) used an oscillating grid to study aquaculture biosolids resuspension and sedimentation at different turbulence levels (expressed as the root mean square of the velocity RMS). An oscillating grid consists of a grid that oscillates in a container. The turbulence generated depends on mesh size, amplitude and frequency of oscillation. The percentage of biosolids in the water column was quantified measuring the turbidity at each RMS. The limitation of the method was that a water sample was taken at each RMS, and consequently the water volume in the container was progressively reduced.

In this work the oscillating grid method has been improved by using a laser beam and image analysis techniques to quantify the percentage of biosolids suspended without removing water samples.

## MATERIAL AND METHODS

Biosolids were collected from a Sea bass tank (50.4±11.8g; Density 9.5 kg $m^{-3}$).
Fish were feed daily at a ratio of 2.5% BW.
Collection of biosolids was made through a siphon, avoiding biosolids disagregration.

Resuspension (R) and sedimentation (S) processes were conducted:
In resuspension trials the RMS were increased gradually every 20min.
After total resuspension, sedimentation trial was started, decreasing RMS every 30min.
Two replicates of the resuspension and sedimentation trials were made.

A horizontal red laser beam was projected above the grid, along a transversal axis of the container. Three images were taken at each turbulence.
Images were analyzed using Image J software.
The red pixel intensity profile along the container was obtained (Fig. 1).

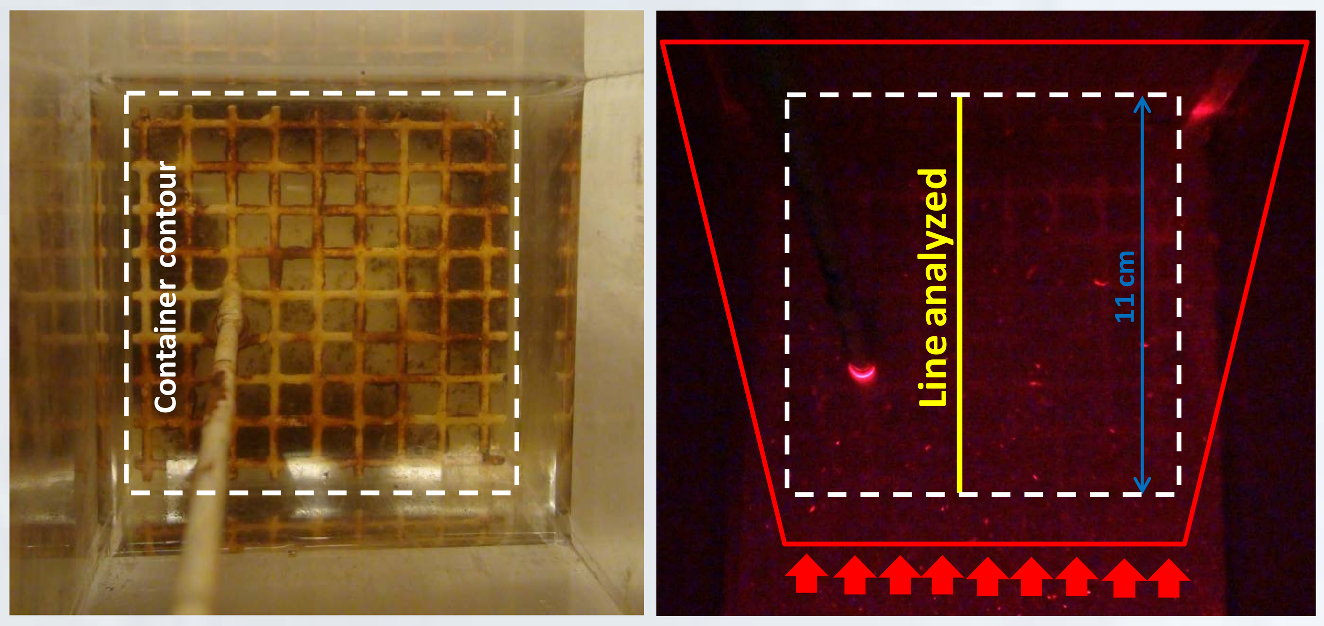


***Fig 1**. Left: Image of the grid with biosolids. Right: Image obtained indicating the laser projection, the container contour and the line analyzed.*

Assuming a uniform distribution of suspended biosolids, the decay per unit length of light reflected along the line analyzed (*dI/dx*) will be proportional to the light intensity (*I*) and to the concentration of biosolids suspended (*C*) (Eq. 1).

$$\frac{dI}{I} = -k \cdot C \cdot dx$$ Eq. 1. Integrating the Eq. 1, we have:

$$I = b \cdot \exp^{-(k \cdot C)x}$$ Eq. 2. In Eq. 2 *b* and *k* are constants.

$k \cdot C$ values are obtained from the pixel intensity profile ($I$ vs $x$) by regression (Fig. 2A)

$k \cdot C$ values are used to obtain the percentage of biosolids in the water column at each turbulence level (RMS) according to Eq. 3.

$$\%\,Biosolids\ in\ the\ water\ column = \frac{(k \cdot C)_i}{(k \cdot C)_{\max}} \times 100$$ Eq. 3

Where $(k \cdot C)_i$ is the value of $k \cdot C$ at a specific RMS and $(k \cdot C)_{max}$ is the maximal $k \cdot C$ value, achieved when RMS is high enough to maintain all the biosolids in the water column

## RESULTS AND DISCUSSION

A higher turbulence level (RMS) leads to a higher percent of suspended solids and therefore to a stronger decrease of light intensity, which can by quantified by the value of the $k \cdot C$ exponent (Fig 2A). This value will not be affected by the intensity of the laser beam projected to the container.

The percentage of biosolids in the column increases with RMS along the resuspension trial, and decreases along sedimentation (Fig. 2B), but during sedimentation, the same RMS levels allow to maintain a higher % of biosolids in the water column (hysteresis).

The new method to quantify the biosolids resuspension and sedimentation reproduces the results obtained in a previous work by Masaló et al. (2008), with the advantage that it is not necessary to withdraw water samples out of the container, maintaining the same water volume along the experiment,

The method can be used to characterize aquaculture biosolids by analyzing its behaviour along sedimentation-resuspension processes. It allows to set the influence of culture conditions (e.g. specie, fish size, feed composition, etc…) in the biosolids dynamics into aquaculture tanks.

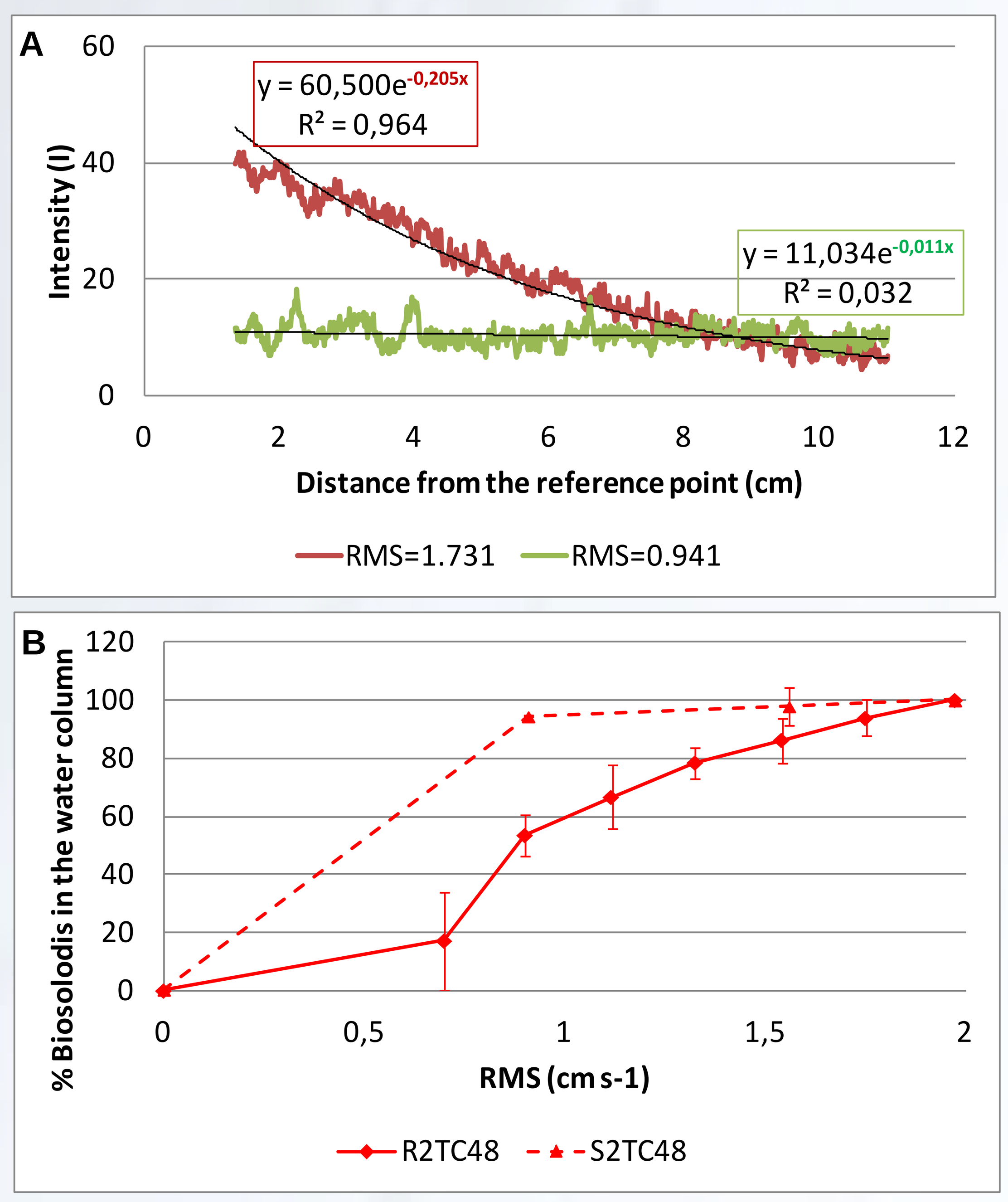


***Fig. 2. A:** Red pixel intensity at each distance from the reference point for two RMS values. **B:** Percentage of biosolids in the water column during resuspension and sedimentation trials.*

## REFERENCES

Masaló, I., Guadayol, O., Peters, F., Oca, J. 2008. Analysis of sedimentation and resuspension processes of aquaculture biosolids using an oscillating grid. Aquacultural Engineering 38, 135-144

## ACKNOWLEDGMENTS

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