FISH SWIMMING MODIFIES FLOW PATTERN IN AQUACULTURAL TANKS

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Introduction

Circular tank geometry is very common in aquaculture because it provides more stable flow patterns, more homogeneous distribution of oxygen and metabolites, better self cleaning features, and higher average velocities than rectangular tanks, thanks to the rotating flow characteristics. In a tank with a rotating flow pattern, like circular tanks, the average water velocity (V_{avg}) is controlled by the inlet impulse force (Fi) (Eq. 1).

$$F_i = \rho Q\left(V_{in} - V_{avg}\right) \qquad \text{Eq. 1}$$

where ϱ: water density, Q: injected water flow rate, and V_{in}: jet inlet velocity.

Average velocity in tanks with rotating flow pattern will be proportional to the square root of the impulse force (Oca and Masaló, 2007).

In addition to the average velocity, also the distribution of velocities is important, since velocity gradient from the outer to the inner area of the tank is found in circular tanks.

Oca and Masaló (2013) proposed a model for determining the distribution of velocities in circular tanks (Eq. 2) by determining the angular momentum per unit mass (β) in different radius of a tank (β in a radius r can be defined as β=V·r). Variables needed to determine velocity (V) in any radius from r=0 to R (R tank radius) are the angular momentum per unit mass near the tank wall (βw) and around the central axis (βo).

$$V = \frac{1}{r}\beta_0^{(1-r/R)}\beta_w^{(r/R)} \qquad \text{Eq. 2}$$

Next to the tank wall (r=R), the velocity is determined by βw (V=βw/r) and when r decreases βo takes more importance in the determination of the velocity. Nevertheless, Eq. 2 cannot be applied in the center of the tank (r=0), were V should tend to infinite. A forced vortex, characterized by velocities proportional to radius is formed in the vicinity of the tank center, due to the increasing importance of friction forces. Therefore, the distribution of velocities in this area is not described by Eq. 2. A linear relationship was found between βw and the square root of Fi, and a linear relationship between angular momentum in the proximity of the tank's center (βo) and Q. The diameter of the forced vortex formed in the tank center was very small

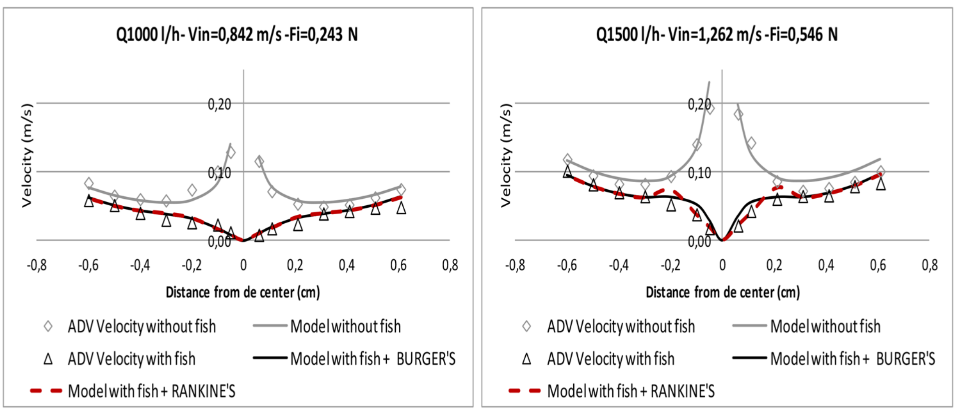

Fig 1. Water velocity profiles obtained and predicted (modeled) with different Fi and Q with fish of 153.90 ± 30.90 g at 14 kg/m^3.

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