

# The Use Of Finite Element Analysis In The Design Of Oil-Water Separators

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**Introduction:** This study aims to use Comsol Multiphysics software to stimulate the performance of different oil-water separators and monitor the effect of different operation and design parameters on the separation. Hence, both time and money could be saved by simulating the separation process using Comsol software without the need of building a prototype.

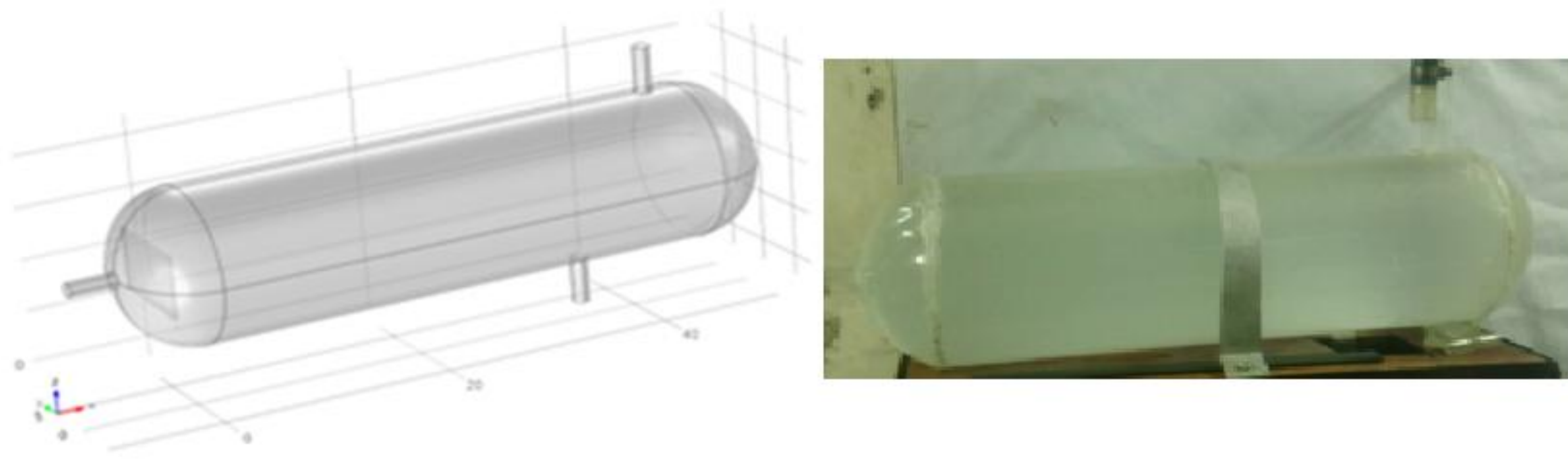


Figure 1. Oil-water horizontal separator models and prototypes

**Computational Methods:** The "Turbulent Two-Phase Flow, Level Set" model was used in the simulation. It depends mainly on the conservation of mass and conservation of momentum using Navier-Stokes equation:

$$\rho \left( \frac{\partial u}{\partial t} + u \cdot \nabla u \right) = -\nabla p + \nabla \cdot \left( \mu (\nabla u + (\nabla u)^T) - \frac{2}{3} \mu (\nabla \cdot u) I \right) + F$$

The separator was designed with an inner diameter of 15cm and a total length of 57 cm. It had an inlet nozzle at the front and two outlet nozzles at the upper and lower ends of the separator. Vanes were added to the design at different locations to study their effect on the separation process.

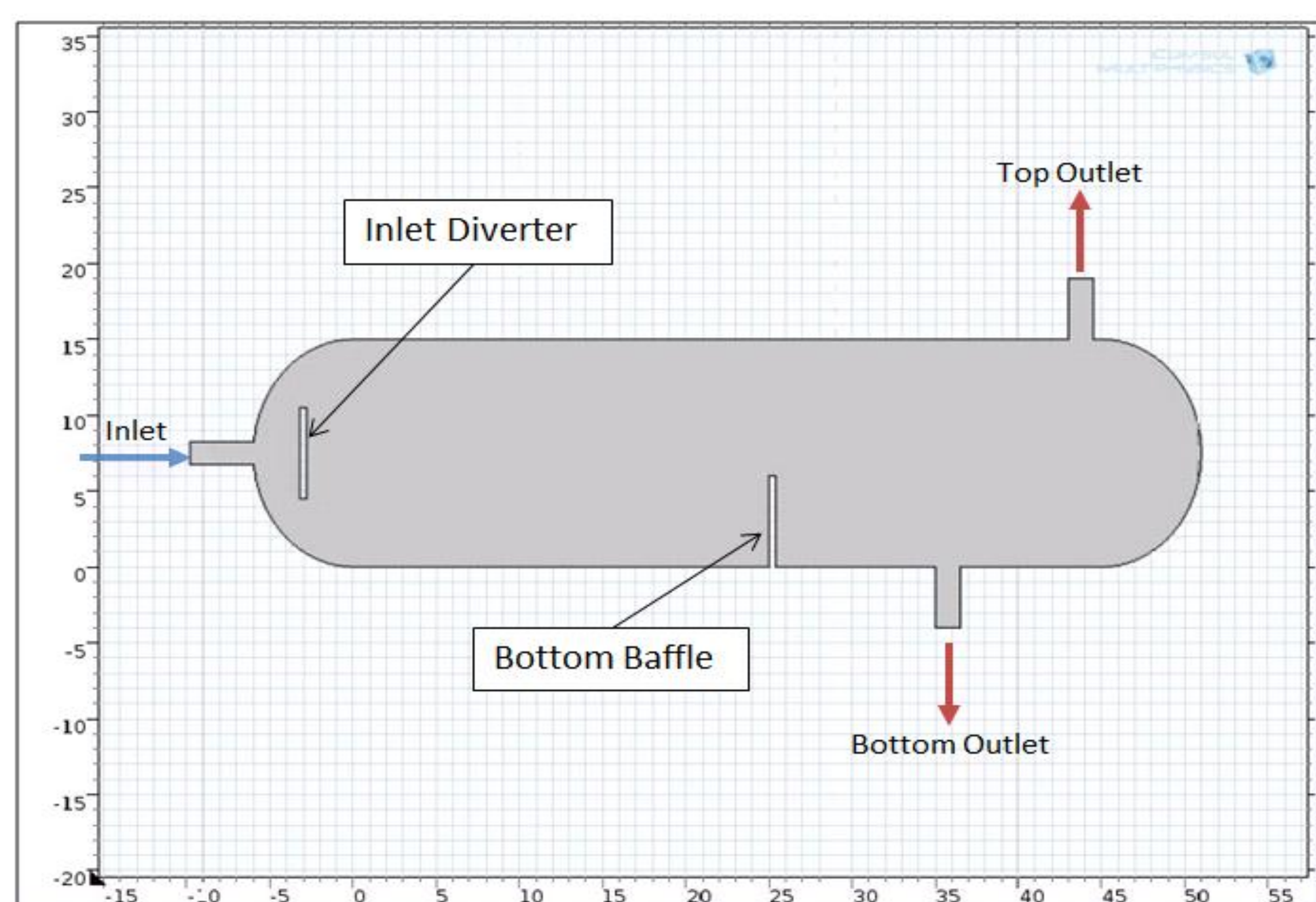


Figure 2. 2D oil-water separator geometrical design

**Results:** A clear resemblance has been seen between Comsol results and results from the laboratory prototype. The reduction in the inlet velocity and modification in the separator's internal design played important roles in the enhancement of separation efficiency.

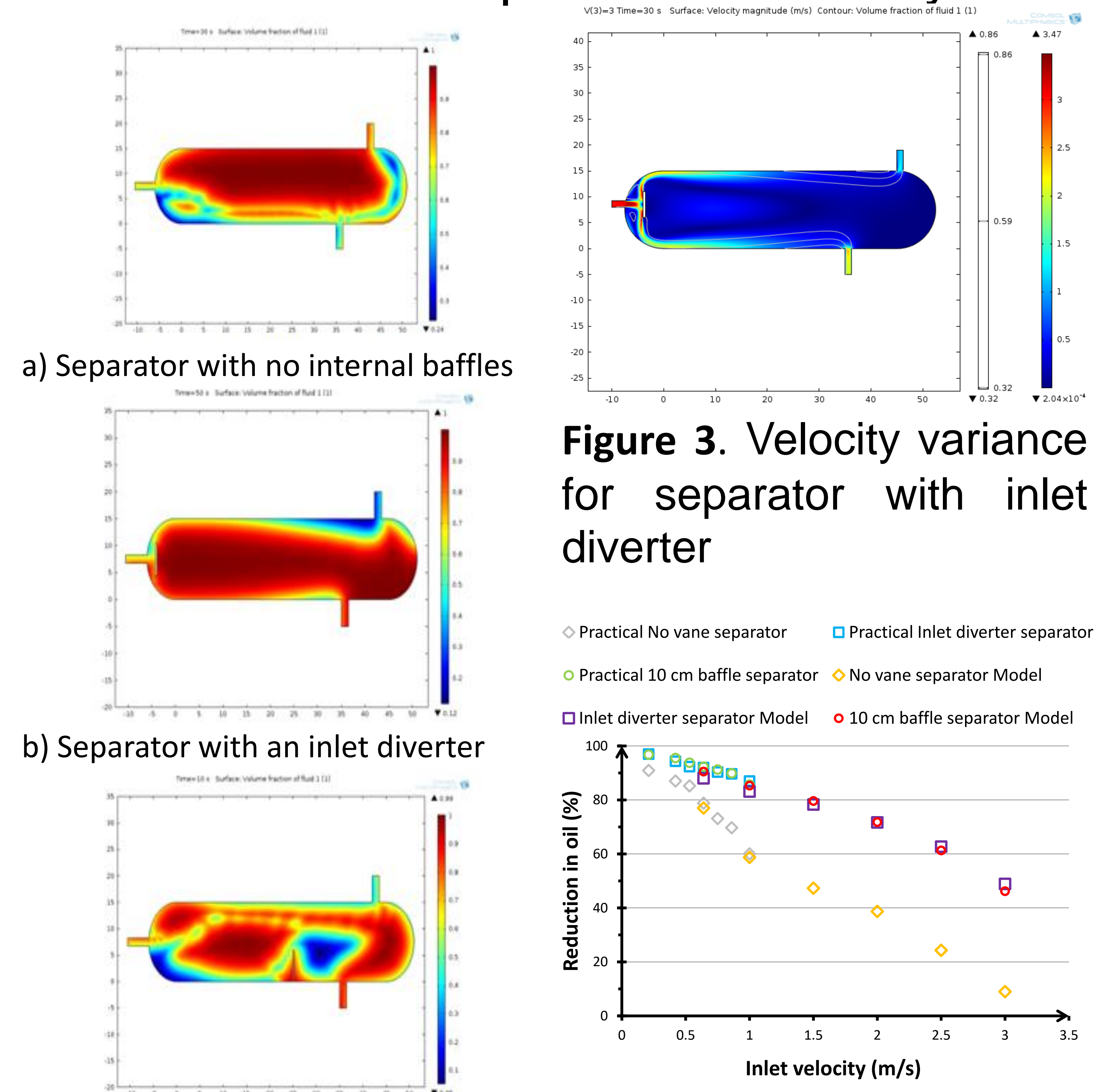


Figure 3. Velocity variance for separator with inlet diverter

**Conclusions:** Comsol software could be used with great confidence to replace the old traditional design methods. The introduction of baffles and their locations inside the separator played great roles in improving of the efficiency.

## References:

1. Venkatesan, et al., Influence of turbulence models on the performance prediction of flow through curved vane demisters. Desalination, (2013.)
2. F.S. Manning, Oilfield Processing of Petroleum: Crude oil, PennWell Books, (1995).