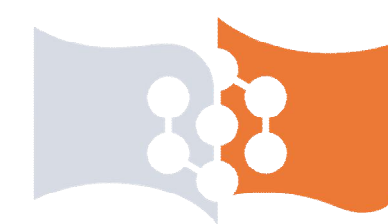




# THE OPTIMAL SHAPE AND EFFICIENCY OF RECTANGULAR SERPENTINE MIXERS IN MICROFLUIDIC CHIPS

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SIBERIAN FEDERAL UNIVERSITY



## Luciferase microfluidic chip

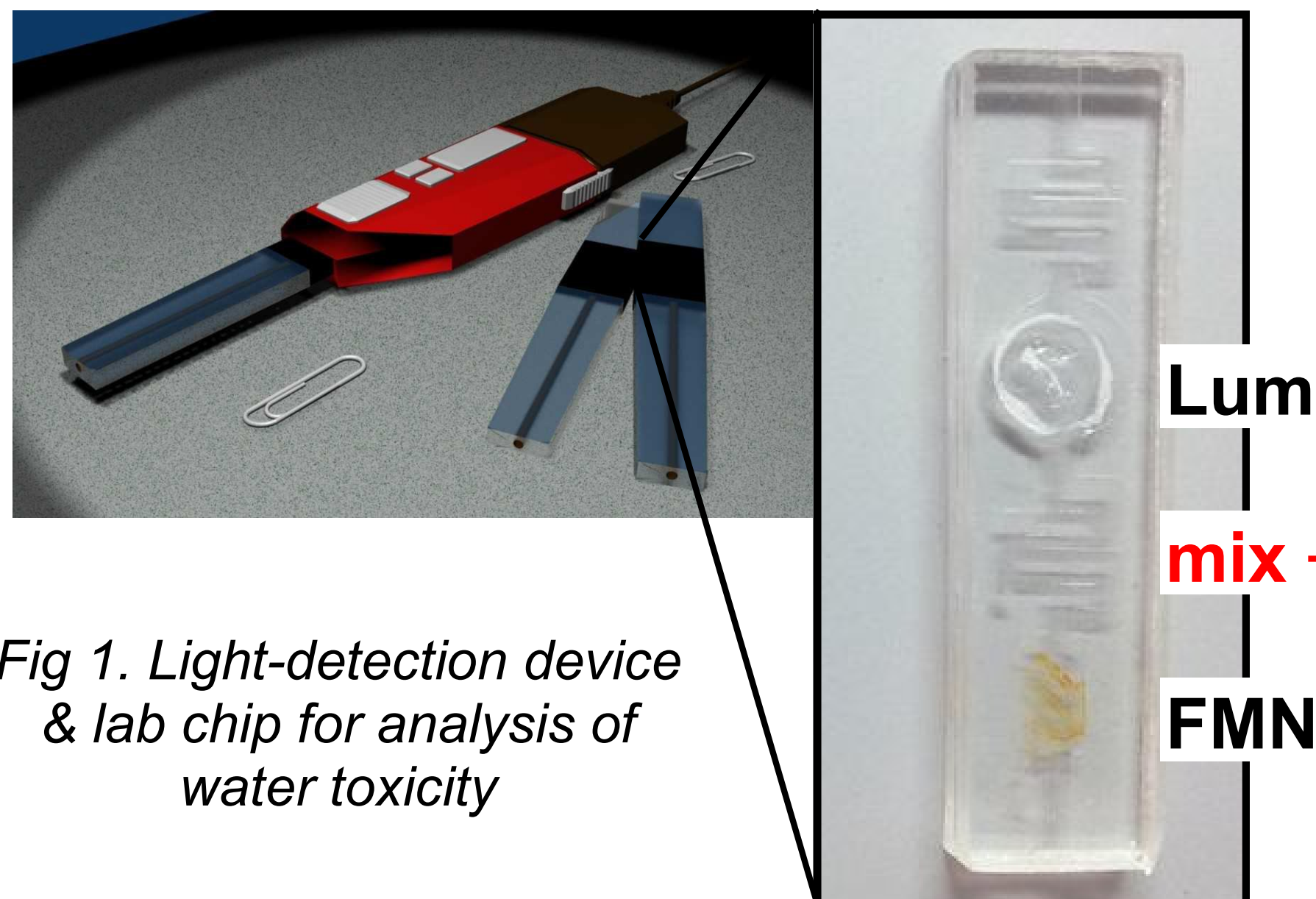


Fig 1. Light-detection device & lab chip for analysis of water toxicity

## What are the rectangular serpentine mixers?

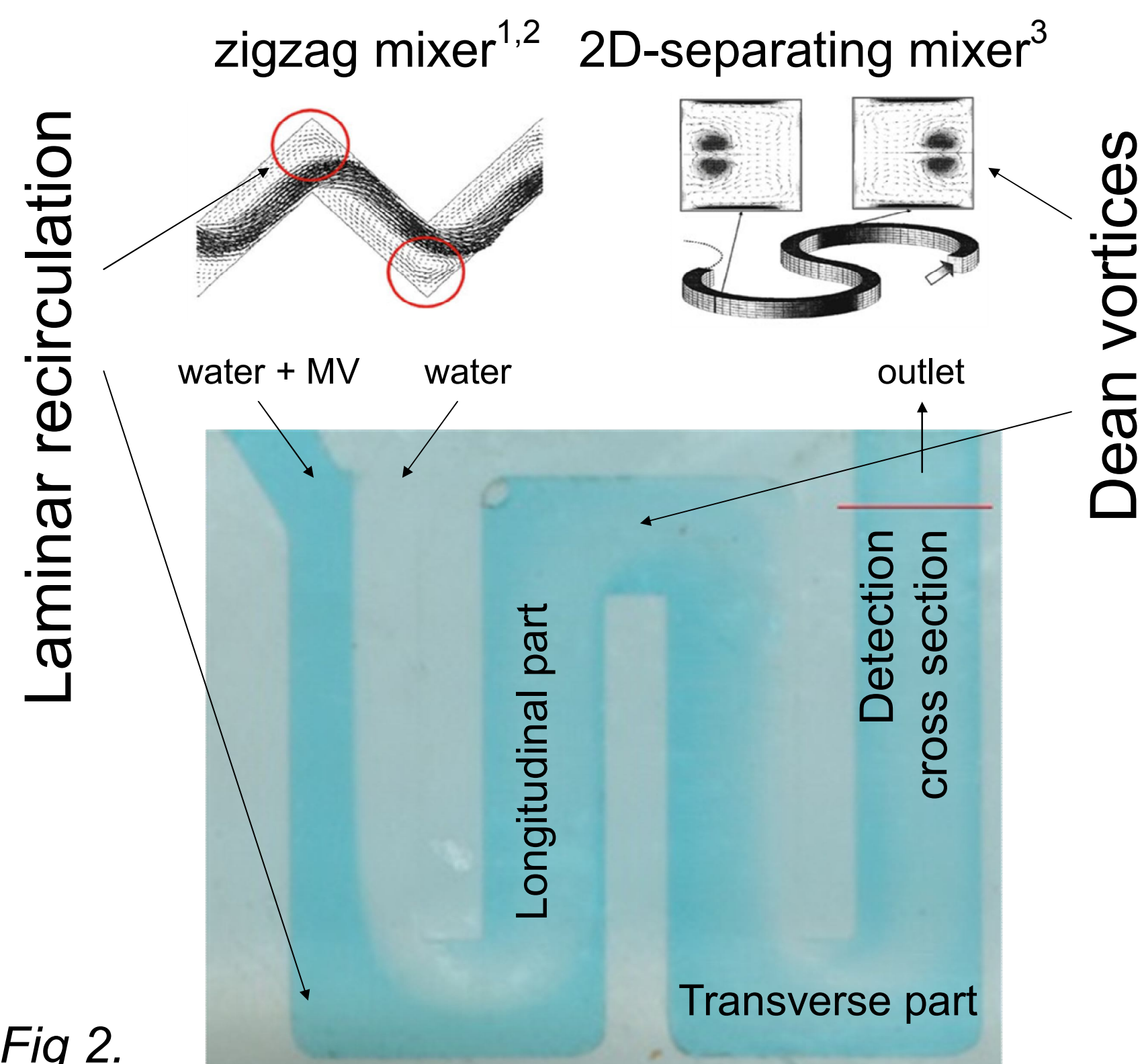


Fig 2.

## Materials and Methods

design and modeling

Google SketchUp  
CADspan

COMSOL

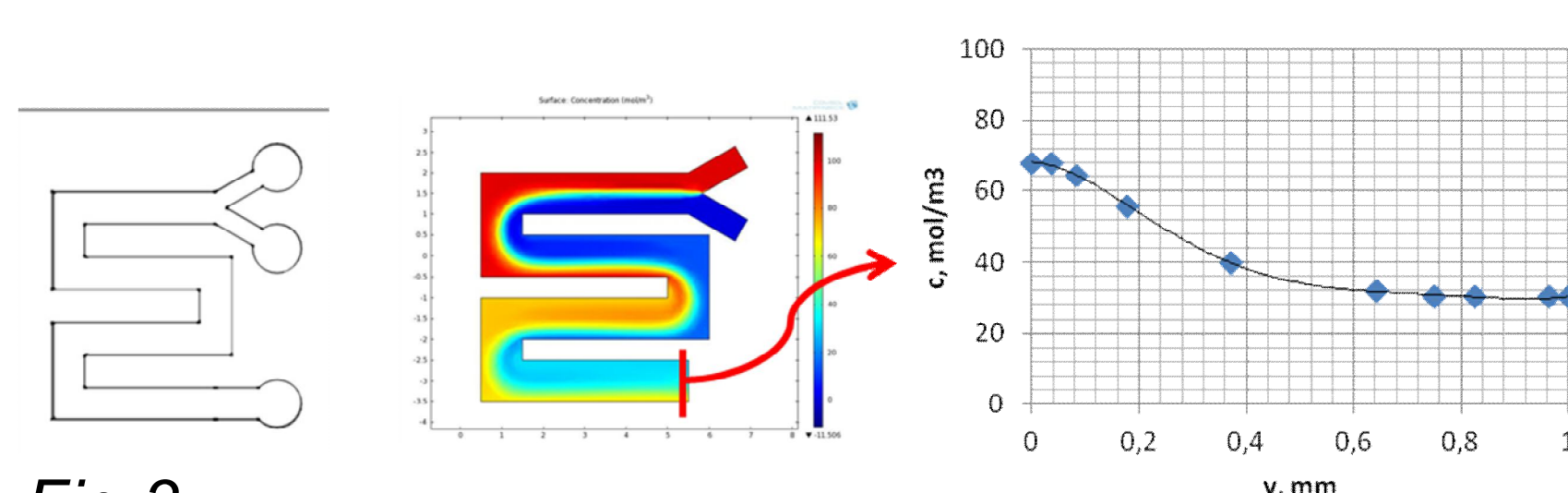


Fig 3.

Mixer intensity distribution was determined by the dye concentration measurements in the outlet channel. The dye concentration was determined by the photometric method with the HP Laserjet G4001 scanner at 1200 dpi. In order to achieve stationary pattern mixing a flow-through system was driven by constant external pressure of 0.05 atm.

## Experimental verification

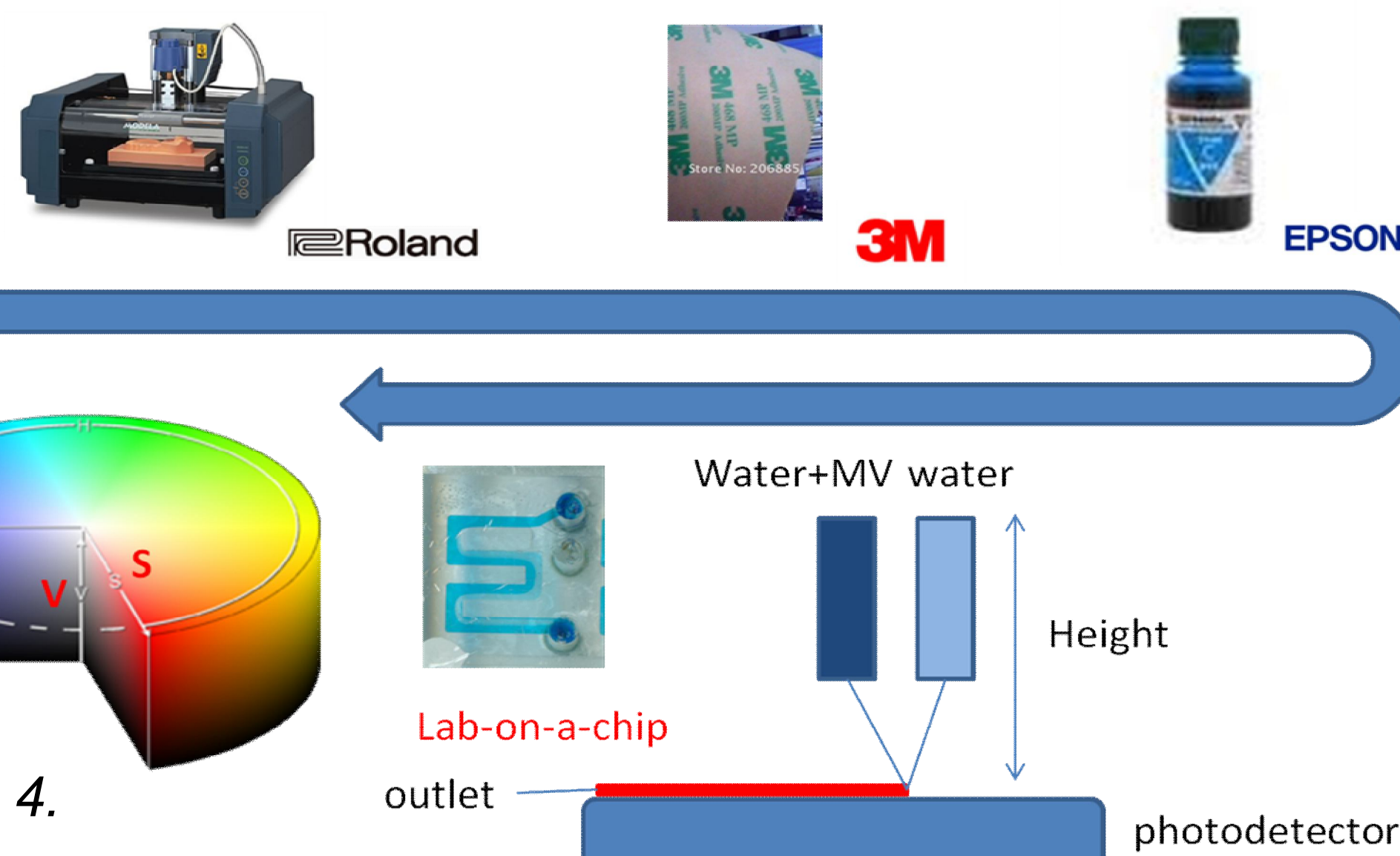


Fig 4.

## Results

Mathematical modeling methods were identified and empirically tested in order to optimize the configuration of the rectangular serpentine mixer: mixer should contain three 180-degree turns for the cross-pieces of 2.5 mm and 4 mm in the longitudinal parts. These parameters provide stirring and ensure the concentration at the outlet to be at  $50 \pm 6\%$  level from the initial value. This mixer is operated at  $Re \approx 1$ , which is much smaller than in zigzag and 2D-separation mixers.

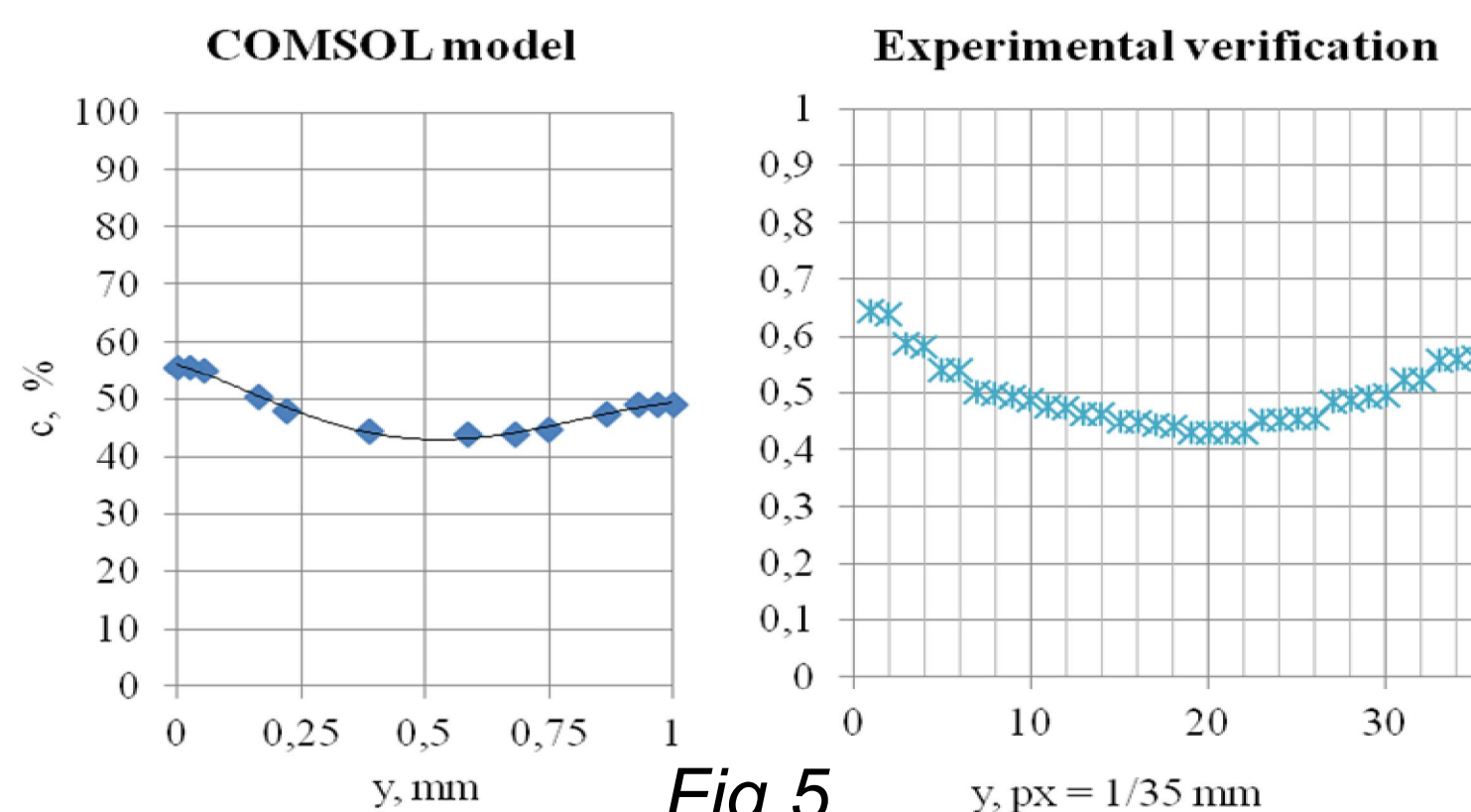
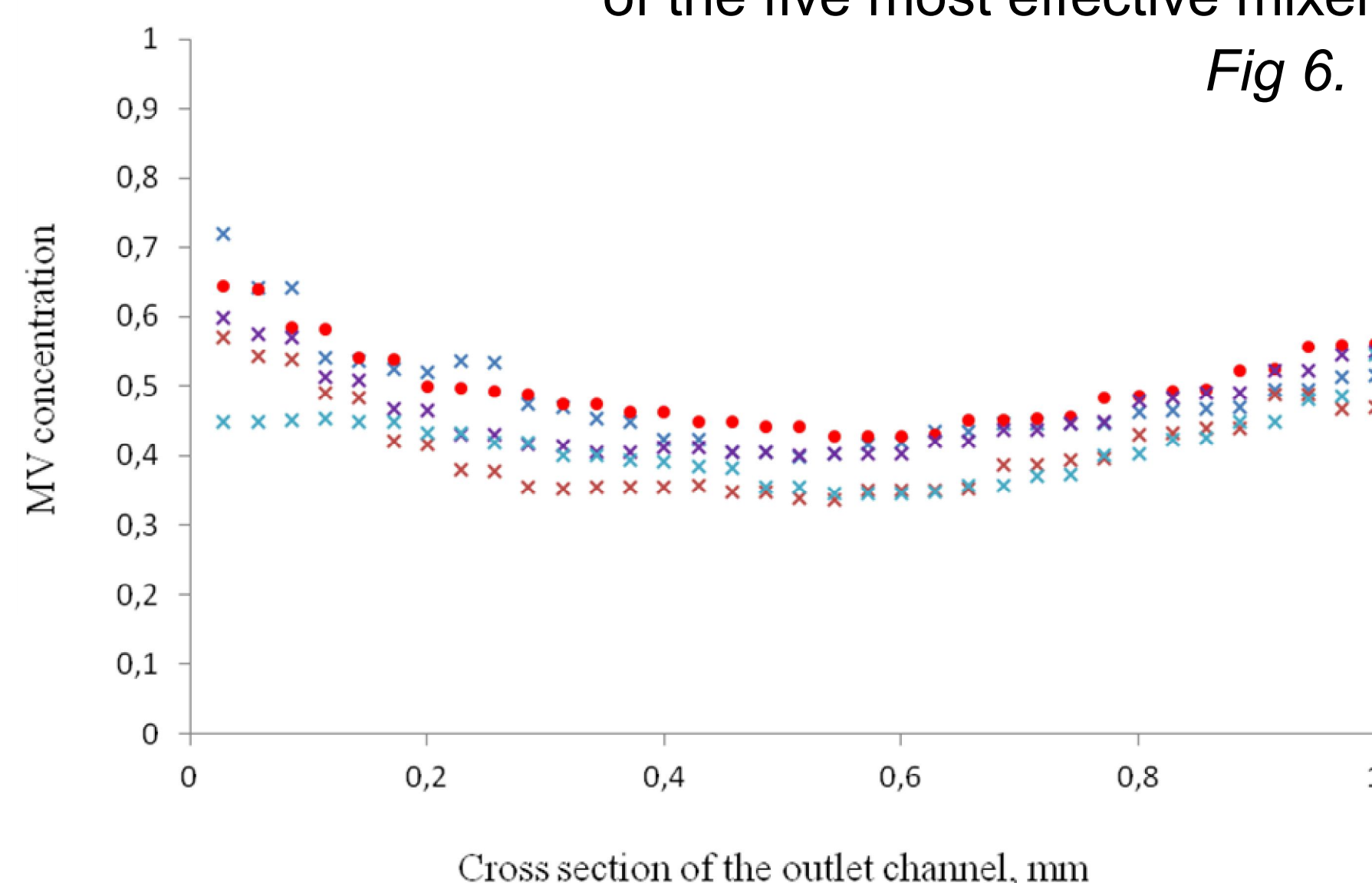


Fig 5.

## Methyl violet concentration in the output channels of the five most effective mixers

Fig 6.



## References

- <sup>1</sup>Capretto L. et al, Top Curr. Chem 304, 27-68 (2011);
- <sup>2</sup>Jiang F. et al, AIChE J 50, 2297-2305 (2004);
- <sup>3</sup>Mengeaud V. et al, Anal Chem 74, 4279-4286 (2002).

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longitudinal × transverse parts, mm	3×3	3,5×3	4×2,5	4,5×3	5×3,5
Arithmetic mean	0,48	0,41	<b>0,50</b>	0,46	0,41
Standard deviation	0,18	0,15	<b>0,11</b>	0,12	0,08