A Presentation on

Effect of geometry of the grooves on the mixing of Fluids in micro mixer channel

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Introduction

- Microfluidics is the study of fluid flow in geometries with one of the channel dimensions being of the micrometer scale.
- These geometries are built-up into circuits known as microfluidic chips.
- One of the main challenges in microchannel is mixing where more than one fluid come together.
- Mixing fluids are used for micro-scale applications.
- This paper investigates flow characteristics and mixing behavior of fluids in micro channel due to three different geometries in micro-channel.
Applications

- Continuous-flow microfluidics.
- Digital (droplet-based) microfluidics.
- Molecular biology.
- Fuel cells.
- Microbial behavior.
- DNA chips (microarrays).
- Optics.
- A tool for cell biological research.
- Future directions.
Material and geometry

- Material of microchannel is **PDMS**.
- Geometry consists of various types of grooves (circular, triangular and rectangular).
- Width of Channel = 200 µm.
- Depth of the channel = 200 µm.
- Length of the channel = 95 mm.
- Circular grooves has radius of 100 µm.
- Rectangular and triangular grooves have also same cross section.
- Inner turning radius 550 µm.
- Outer turning radius = 750 µm.
- Angle between two inlets = 60°
- Two fluids are water and acrylene orange dye.
- In COMSOL, water and a fluid whose properties resembles with acrylene orange dye is taken.
- Inlet volume flow rate is 10µl/min.
- Input concentration of dye is 20 kg/m^3.
- Input concentration of water is 1 kg/m^3.
- Inlet velocity, viscosity and pressure of fluids were kept constant.
Analysis and Discussion

- Different cases are analyzed.
- Graphs in concentration vs length of the channel is plotted.
- The length of the channel for mixing of fluids is optimized.

❖ Case 1: Channel with one triangular, one rectangular and one circular groove separately before each bend.
- Optimum length for circular grooves: 55,000 μm.

**Fig. 2:** Mixing behavior of two fluids in a microchannel having one circular groove.

**Graph 1:** The effect of single circular groove on concentration of mixing in microchannel is having input velocity 20 μl/min along the channel length.
- For triangular grooves: 60,000 μm

Fig. 3: Mixing behavior of two fluids in a microchannel having one triangular groove.

- For rectangular grooves: 57,500 μm

Fig. 4: Mixing behavior of two fluids in a microchannel having one rectangular groove.

Graph 3:- The effect of single triangular groove on concentration of mixing in microchannel.

Graph 3:– The effect of single rectangular groove on concentration of mixing in microchannel.
**Case 2:** Channel with two rectangular, two circular & two circular grooves separately before each bend.

- Number of grooves increased, more proper mixing.
- For circular grooves: 40,000 μm.

**Fig. 5:** Mixing behavior of two fluids in a micro channel having two circular grooves.

**Graph 4:** The effect of two circular grooves on concentration of mixing in microchannel.
For rectangular grooves: 40,000 µm

For triangular grooves: 45,000 µm

**Fig. 6:** Mixing behavior of two fluids in a microchannel having two rectangular grooves.

**Graph 6:** The effect of two rectangular grooves on concentration of mixing in microchannel

**Fig. 7:** Mixing behavior of two fluids in a microchannel having two triangular grooves.

**Graph 5:** The effect of two triangular grooves on concentration of mixing in microchannel
Case 3: Channel with three circular grooves before each bend.
- Optimized channel length is 35,000µm.

**Graph 7:** The effect of three circular grooves on concentration of mixing in microchannel

**Fig. 8:** Mixing behavior of two fluids in a microchannel having three circular grooves.
Case 4: Channel with one circular, one rectangular and one triangular simultaneously before each bend.

Optimize length of the micro channel is 35,000µm.

Fig. 9: Mixing behavior of two fluids in a micro channel having one triangular, rectangular and circular groove.

Graph 8: The effect of one triangular, rectangular and circular groove simultaneously on concentration of mixing in microchannel
Conclusion

From the above study and simulation it has been concluded that:

- When we are increasing the number of grooves, the mixing length for proper mixing is decreasing.

- Mixing is affected by the geometry of grooves. Better mixing is obtained for circular groove case having three circular grooves before bend.

- The optimum length for mixing is found to be 35,000μm.


THANKING YOU