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Optimization and Use of 3D sintered porous material in medical field for mixing fibrin glue.

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In medical field, Mixing of two or more chemical components (liquids and/or gases) is extremely important as improper mixing can affect the physico-chemical properties of the final product. At Baxter Healthcare Corporation, we are using a sintered porous material (PM) as a micro-mixer in medical device for mixing Fibrinogen and Thrombin in order to obtain a homogeneous polymerized Fibrin glue clot used in surgery. First trials were carried out with an interconnected PM from Porvair® (made of PE – porosity: 40% - permeability: 18Darcy). The injection rate is very low, usually about 10mL/min (Re number about 50) which keeps fluids in a laminar flow. Such a low flow rate does not favour mixing of fluids having gradient of viscosity if a mixer is not used. Promising results that were obtained lead the team to understand this ability to mix fluids which will be presented in the poster.
Topology of porous media (PM) which associates a solid phase with interconnected (or not) porous structure is known and used in many commodity products. Researches on PM usually focus on flows inside this structure. By opposition to transport and filtration capacity, as well as mechanic and thermic properties, mixing is rarely associated with PM. However over the past few years, we shown that some type of PM have a real capacity to mix certain fluids.

Poster will also describe the problematic of mixing complex biological fluids as fibrinogen and Thrombin. They indeed present a large viscosity difference (ratio about 120) limiting the diffusion and the interaction between the two solutions. As those products are expensive, we used Water (1cPo) and Glycerol 87% (120cPo) which are matching the viscosities of Thrombin and Fibrinogen.
A parametric investigation of the "porous micro-mixer" as well as a scale up investigation was carried out to examine the influence of both diffusion and advection to successful mix fluids of different viscosity. Experiments were implemented with Planar Laser Induced Fluorescence (PLIF) technique to capture the evolution of concentration gradients at the mixer outlet. Apparatus layout, flow rate and scale up which are critical parameters influencing the mixing efficiency will be described on the poster.

Porous micro mixer was analyzed by Computed Fluid Dynamic (CFD) to compare the results with the experimental data obtained using PLIF. A clear correlation can be made between data from both techniques show that main effect of the mixing performance using PM with fluids of different viscosities is the development of a transverse "hydrodynamic jet" of the less viscous fluid at the outlet of the PM.