ADAPTIVE FLOW GEOMETRY, FLEXIBLE VALVES AS A KEY FOR FLUID DEPOSITION TECHNOLOGY

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Subject of our research focuses on straightforward interaction between structure, flow and processing. For that we take Chocolate deposition process as complex application where processing binds rheology and fluid dynamics. Traditional deposition process is based on utilization of classical mechanical deposition system where mechanical actuator drives depositing plunger. The plunger presses liquid chocolate through multiple flow channels made of solid walls. The challenge of such chocolate processing comprises non-stationary simultaneous flows through geometrically different flow channels.

How to compensate differences in structural state? How to control different pressure fields and thus deviating from flow channel to flow channel structural state of chocolate suspension? Such challenges can only be solved by radical solution that avoids core sources of flow instabilities, rigid channels of different geometry and rigid nozzles at the outlet of each deposition channel.

Mimic of Heart Valve found to have an exceptional capacity of simultaneous self adjustment to fluid flow properties and flow it self. Accounting on adaptive mechanism interaction between fluid and flexible nozzle becomes solution to low pressure, fast and precise deposition principle with reduced and in some cases without post-flow.

Experimental results show how to balance pressure, flow velocity and fluid properties within self adaptive geometry making fast control of deposition possible. The property of the valve to seal the flow channel, allows vacuum pressures to be applied during refill procedure. This in tern strongly reduce, eliminate post-flow and tailing.

Facing proven above, exceptional reaction time of “Heart Valve” flexible nozzle, 100 ms deposition cycles become technologically possible. Nevertheless stability of elastic materials and high load at high deposition speeds forces to develop spatial materials that can withstand millions of deposition cycles without loosing their elastic properties.

Understanding of fluid mechanics and interaction between fluid and flexible interface has been translated into revolutionary depositing technology.