Bubble mattress reduces drag in fluidic chip

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Researchers at the University of Twente's MESA+ research institute have given the first demonstration of how the drag exerted on liquids flowing through tiny "fluidic chips" is affected by the introduction of diminutive gas bubbles. Armed with this knowledge, scientists can directly manipulate flow resistance in a variety of applications involving combinations of liquids and gas bubbles. This could be useful in areas ranging from the manufacture of fizzy drinks to the development of artificial lungs.

This research has been published in the *Proceedings of the National Academy of Sciences* (*PNAS*).

The theoretical principles of how the shape and size of gas bubbles affect the drag exerted on an overlying fluid were already well understood. Even though this area has been the subject of intensive research for more than twenty years, the precise details of this relationship have only recently been experimentally demonstrated. Researchers at the University of Twente's MESA+ research institute have now developed a tiny "fluidic chip" that can be used to accurately measure the extent to which miniscule gas bubbles affect the drag exerted on flowing liquids.

Using this approach, the researchers in this study measured a 21 per cent reduction in the flow resistance of liquids passing across the chip. Prof. Rob Lammertink, one of the scientist involved, says that even greater reductions are definitely achievable.

Fluidic chip

The fluidic chip developed in this study features two minute channels, running parallel to one another, each with a diameter of only 100 micrometres (one micrometre is a thousand times smaller than a millimetre). A liquid flows through one of these channels and a gas through the other. These minute channels are interconnected by even smaller channels, which are used to introduce diminutive bubbles of gas (about ten micrometres in diameter) into the liquid. These tiny bubbles coat the wall of the fluid channel, forming a "bubble mattress". This affects the drag exerted on any liquid flowing across that area. By varying the gas pressure, the researchers can control the size and shape of the bubbles. This allows them to accurately measure the bubbles' effect on the drag exerted on the liquid.

While the research in question involves extremely fundamental physics, Prof. Lammertink is convinced that it will eventually generate a range of practical applications. "Such knowledge could be useful in the development of artificial lungs, for example, in which blood is oxygenated by flowing across an artificial membrane. Another potential application is dissolving carbon dioxide in fizzy drinks, such as cola."

The article is titled "Control of slippage with tunable bubble mattresses."

More information: www.pnas.org/content/early/2013/05/01/1304403110

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