Experimental Investigation of Cavitating Herschel Venturi-Tube Configuration

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The flow in cavitating nozzles is a long time subject of experimental as well as numerical investigations. Although their choked flow condition is well known for about a century, they represent a fairly new way of metering liquid flow and are only recently being considered in more detail in regards to their metering capabilities.
For a flow acceleration high enough to drop the local pressure to the respective vapour pressure, a so-called sheet cavitation will develop along the wall, starting at the throat entrance. With increasing pressure difference the vapour cavity will grow in length and start to extend into the diffuser section. Only for vapour cavities being longer than the cylindrical throat section, the chocked flow condition sets in.
For the purpose of gaining further insight into the chocked flow condition with respect to liquid flow measurement, high-speed camera investigations of a transparent Herschel Venturi-tube configuration were being performed. Together with pressure and flow rate measurements they demonstrated the overall stable flow behaviour of the investigated Herschel Venturi-tube under chocked conditions. Furthermore, based on the experimental investigations, a first, simple correlation for the calculation of the actual flow rate is proposed. As the actual throat pressure can't be measured under cavitating conditions (the pressure tap is covered by the vapour cavity and thus will only measure the vapour pressure) this correlation provides a workaround, still with some limitations though.
The full paper will present a detailed discussion of the above aspects of the cavitating nozzle flows under various conditions.