The proposed project, ATHLETE, aims to better understand the mass and thermal, and phase separation mechanisms occurring in Ranque-Hilsch Vortex Tube (RHVT) and their qualitative potential of improvement when the vortex tube is incorporated in emerging engineering systems.

What Investigation of mass, thermal and phase separation in the Ranque-Hilsch vortex tube: from fundamentals to technological concepts in energy and process engineering

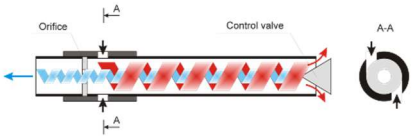

Fig. 1. Flow pattern in a vortex tube (RHVT)

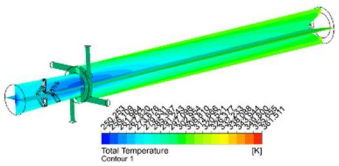

Fig. 2. Streamlines distribution along the vortex tube (RHVT)

Who Silesian University of Technology
Niccolò Cusano University

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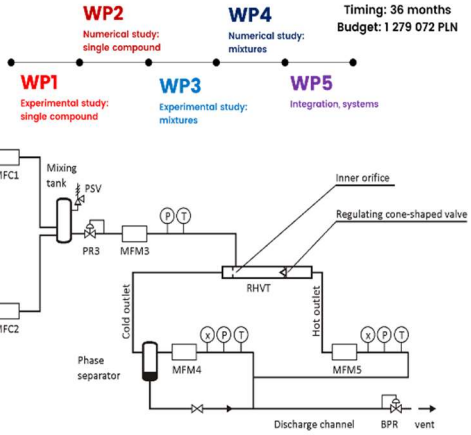

Fig 3. Key elements of the experimental test rig.

The RHVT separates a high-pressure inlet flow into two expanded flows: a hot and a cold one (Fig. 1). Part of the hot stream exits at the hot end, while the remaining part returns towards the cold end. The fluid is swirling in at least two swirls with a velocity of even 1 million rpm (Fig.2). The vortex tube is used in special applications, for example, to generate a cooling effect if compressed air is available.

ATHLETE will represent the most advanced research of the vortex tube at the global level. The main advancement with respect to the current state of the art is the investigation of complex problems, where the inlet compressed gas consists of two or more compounds and is characterized by particular inlet and outlet conditions (i.e., supercritical fluid, two-phase flows). The compounds can separate at the tube, and it is expected that heavier gases exit at the hot end. Some practical applications could be proposed, but the mechanism is still not known well enough.

The project responds to the considered problems through the realization of specific objectives: experimental and numerical studies, simulation analysis, and demonstrating the advantages of integrating an optimized vortex tube design into energy systems. The synergies between the Silesian University of Technology and Niccolò Cusano University and their multidisciplinary already developed knowledge will be the driving factor for the success of the ATHLETE project. Within the project, a team of researchers from 3 departments of the Silesian University of Technology will do experiments (Fig.3) using gases that can safely be tested in a laboratory. In parallel, they will design a numerical twin of the tested object using high-accuracy software for fluid flow modeling. The researchers also plan to visualize the flow inside the tube using the most advanced visualization techniques, such as seeding fluorescent nanoparticles.

The driving factors for the success of the ATHLETE project are the deep knowledge of each partner in his field of expertise; the accurate methodology that embraces the latest approaches for the RHVT experiment, analysis and modelling; the strong synergies between the complementary partner experiences.