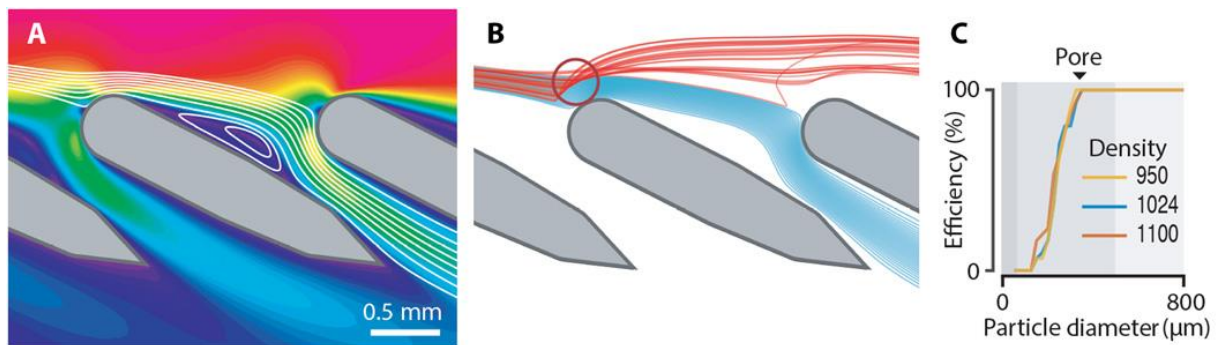*The promising Ricochet Effect*

Introduction

Nature has evolved and optimized itself over centuries through natural selection. Therefore, it represents an abundant source of knowledge and inspiration. Biomimicry is a process of innovation, where the strategies of nature are understood and mimicked, in order to tackle technical challenges. The gills of Manta Ray are a great example of such an optimized system. Thanks to the ricochet effect [1] the Manta can filter plancton out of the water efficiently without their gills clogging.

What is the waste challenge?

With increasing processing and different possibilities of recycling, the subsequent separation of materials and chemicals is becoming crucial. Filters play an essential role here. Through them we separate the clean from the dirty, the recyclable from the non-recyclable or the waste from our nature. One problem with filters, however, is that they clog and thus become waste themselves at the end of their lifecycle. A characteristic not shared by the filtering gills of the manta ray. Due to the flow characteristics of the gills, which are lined up next to each other, particle-free water can pass through or

Hence, the Ricochet Effect seems to be a promising strategy to tackle some great waste issues. However, it introduces new challenges that need to be solved. Since the water flow must be maintained via the gills/fins, a kind of dirty water and fresh water cycle is created. Further, flow velocity and flow angle must remain constant or at least be adjustable. One could try to solve these challenges, however, it may also be that there are already applications where the difficulties of this solution are not relevant and the advantages can be utilized. Accordingly, we pose the following challenges to you.

- How can the ricochet Effect be used in a technical setting?
- Define a waste problem that could effectively be tackled using the ricochet effect.
- Find limiting factors of the Ricochet Effect, and how one might overcome them.
- How can the Ricochet effect be utilized and expanded upon to tackle current waste challenges we are facing?

Who is behind this challenge?

We are a team of 7 motivated students from various fields of studies. Within the TUM:Junge Akademie we have joined forces to form the team Membrains [2]. The fact that we can all draw so much from the work on our project, has motivated us to set this challenge. We are curious about your creative ideas, open input and potential solutions to the subject we are passionate about.

Topic domain of challenge: Cities, Energy or Consumption

We believe that this challenge fits into all three categories, depending on how the students interpret the question.

Desired Impact of Challenge:

We believe that novel filtration methods need to be developed in order to tackle the ever increasing waste problem. By taking inspiration in nature large steps can be done in a short amount of time, as the working concept is proven. Due to its low clogging properties the ricochet effect could have a significant impact on sustainable permanent waste removal solutions. However the focus remains on removing dirt from the environment and feel free to add your thoughts to the main idea.

Skills needed/recommended

The module is open to everyone but some skills might be especially useful for our Challenge

- *Fundamental understanding of fluid mechanics?*
- *Engineering fundamentals?*
- *…*

For further investigation of the idea a tutorial for Ansys a fluid simulation software will be provided, which can be used by TUM students. For very eager students we are able to provide a testing ground for their built prototype, which uses standard tubing and a water pump.

Relevant considerations for the challenge / theme:

The team is free in their use of biomimicry to tackle this challenge. Though the main interest of the challenge should be the ricochet effect, it might be interesting to look at other animals or plants for further inspiration. Focus should be put on one of the key questions.

Relevant links:

[1] https://www.science.org/doi/10.1126/sciadv.aat9533
[2] https://www.ja.tum.de/ja/projekte/2022/membrains/

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