Imperial College London

Dyson School of Design Engineering

Turbomachinery systems to collect micro/macro plastics to filter river and ocean flows

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Currently ~5.25 trillion pieces of plastic debris exist in the world's oceans (5-Gyres-Institute-2015), with 17.5M additional tonnes forecasted to enter each year by 2025 (Science-2015), 95% of which enters through just 10 rivers (Helmholtz-Centre-for-Environmental-Research). The effects of plastic pollution on human health/tourism/greenhouse gas emissions/wildlife cost ~$13Bn/year (UN-Environmental-Assembly-2017) and annually causes deaths of ~1M sea-birds, 100,000 sea mammals and countless fish (Phys-Org-2017).

Despite the awareness that an immediate worldwide action is needed to address this challenge and with a 2017 UN resolution to stop plastic entering the oceans, there are limited solutions for collecting plastics once they have entered into the water systems, with plastic collection negligible compared to plastic input.

Researchers at the Dyson School of Design Engineering in collaboration with an industrial partner seek to to deliver the first truly scalable solution to reduce the flow of plastics into the world's oceans by developing a novel, versatile turbomachinery system. The technology that is being developed uses streams and currents to produce the energy that it needs to operate. This means that the operational carbon footprint of this technology is close to zero as it is a self-energy-generating novel device that uses renewable energy. The technology acts as an upgrade to existing infrastructures, adding in plastic reclamation and filtration. This means solving a problem without creating another; a sustainable development that is "to meet the needs of today without compromising the ability of future generations to meet their own needs".

Advanced technology inspired by nature:

Biomimicry (or biomimetics) is is an approach to innovation through a process of learning from and then emulating nature's ingenious solutions to complex problems (Benyus 1997). One important aspect of the design development of this project is inspired by the feeding mechanisms of manta rays, basking sharks and paddlefish. Research has already been done on how the filtration mechanism of these species may be helpful for developing "self-cleaning" filtering structures (Sanderson et. al 2017). The research also suggests that these structures prevent clogging by creating a vortical cross-step filtration model, where the flow goes tangentially across the filter surface, rather than perpendicular.

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