1 Marine plastic pollution

Marine plastic pollution is a widely documented issue. The exact amount of plastic is not known. The world$_e conomic_f orum_t op_2 022 estimatetheretobebetweel 75 and 199 millionmetrictonsofpla$

2 Why's it an issue

Health effects, effects on animals etc., effects on the conditions in the ocean (acidity etc.). There's also very little research going into it currently.

3 What are we doing about it

Solving the problem of marine plastic pollution can be seen as a layered approach. In the first layer is reducing the use of plastics in general. Particularly single use plastics should be reduced as much as possible, but more sustainably produced options made from natural materials should also be considered for things like clothing, crates, liners for fluid tanks or other places where plastics are used today.

Still, there are some areas of life in which the use of plastics or single-use plastics cannot be removed practically. Healthcare is an example of this, where single-use items are necessary for hygeine considerations, as well as for practical purposes. For instance having intravenous needles not made from plastic was done before, but they are far less comfortable than their modern plastic counterparts.

In cases like these, as well as others, the second layer steps in. The second layer here is increased or improved collection. Waste which is collected correctly doesn't end up in the natural environment. Having proper recycling efforts, as well as waste collection systems for consumers and industry is a massive boon here. Additionally under this layer is solutions such as river collection nets and similar. These solutions are made to catch waste which happens to get into the waterways or wastewater treatment system before it is released into the sea. However, environmental studies need to be performed to ensure undue ecological damage isn't done by essentially demming up rivers or waterways.

The two layers described above are helpful to prevent waste from getting into the oceans, as the saying goes "an ounce of prevetntion is worth a pound of cure". There are two problems with relying only on those two layers, however. Firstly, some litter inevitably slips through the cracks of the systems and ends up in the ocean despite our best efforts. This is unavoidable and will always be a problem so long as plastics exist. Secondly, and arguably more importantly: there are already many million tons of waste in the ocean. Even if our prevention efforts were perfectly implemented with no "leaks", the harm is already done, or in the process of being done as is the case with leeching. Thus, the third layer is necessary.

The third layer of this solution is removal. By removing the waste from the oceans, it is possible to halt its harmful future effects on the environment.

The ideal solution to marine plastic pollution is to simply not pollute the oceans, as the saying goes "an ounce of prevention is worth a pound of cure". There are several programmes already in effect to both collect refuse from people and industries on land and sea, as well as for collecting litter which still makes it into the waterways or wastewater management system. These programmes are absolutely helpful and valuable, but they don't remove the problem already existing. As mentioned in the previous section, plastics have a detrimental effect on the environment, both physically, chemically and biologically. There is still a need for a solution that removes plastic and other waste that exists in the sea already, remedying the harm already done. In addition, such a solution would be useful as a third layer in prevention, collecting whatever litter still makes it through the previous two layers. Through both reduction of plastic use and increased collection, most of the

3.1 Plan Sea project

The Plan Sea project is an, at time of writing, ongoing student-led project at NTNU in Ålesund. The goal of the project is to find a solution to the problems of subsurface marine plastic pollution as laid out above.

3.2 Previous work (Specialization project)

This report is in a way a continuation of a specialization project[**?**] done previously. The specialization project has always had the goal of being the groundwork for this master's thesis. The goal of the specialization project was to set up a framework to make work for the master's project easier. Part of the specialization project has been starting work on a simulator that can be used to work on a control system. The control system is currently rudimentary implemented and there is room for improvement.

The goal of the development for the conttrol sytem is to have it be platform agnostic. That is, the control system does not care whether it's connected to a simulator or a vessel in the real world. The way this is ideally implemented is by using ROS2. ROS2 is a framework to control robotics, built around publishers and subscribers that all act around topics.

An ideal solution will have a

4 How are we doing it

A system consisting of two distinct but connected parts. A surface vessel and a connected, non-buoyant remotely operated gripper.

5 Reader's guide