

# EXTRUSION

Input materials	Pre-condition/Pre-treatment	Operation & maintenance needs	Objectives / Key features	Key technical parameters
<b>Suitable plastic waste:</b> <ul style="list-style-type: none"> <li>- HDPE or</li> <li>- PP</li> </ul>	Waste segregation at source  Clean, dry and shredded homogenous plastics (HDPE or PP)	Regular flushing of extruder with virgin material is recommended	Process of extruding plastic waste into a continuous filament to create new product	Voltage: 380V AMP: 5.8A Nominal power: 1.5kW min Output speed: +/- 40-140 r/min [1]
Outputs / products	Technical complexity	Maturity level	Educational aspect	
Plastic filament, plastic beams, ornaments/ decorative objects, etc.	Higher-level skill required for appropriate design & construction of infrastructure  Medium-level skill required for setting up and operations	Proven technology with large internet-based community of practice to provide support	<b>Topics:</b> Plastic litter reduction; Consumption <b>Practical exercises:</b> Calculation of plastic quantities per produced items	



**Plastic extrusion is an upcycling technology that converts discarded plastic waste into a continuous plastic filament, which can be further molded into any desired end-product shape.**

Clean and shredded homogenous plastics such as HDPE or PP are put through an extruder, where plastic is transported by a screw powered by a motor, to the heating section of the machine. The heat created by the machine along with the pressure created by the screw allows the plastic to melt, and it passes through a nozzle. A continuous plastic filament exits the nozzle. A mold can be placed at the end of the nozzle to receive the melted plastic filament and shape it into the mold shape.

**Applicability:** Plastic extrusion is a process that can be used from small to large industrial scale. The design and infrastructure presented here shows a small-scale application (e.g. at communities or neighborhoods level).

**Design considerations:** Extruders can either be built from scratch or purchased from the "Precious Plastic" bazar. Higher-level skill is required for appropriate self-design & construction of the extruder. Link to blueprints for extruder construction are available in the references [2].

**Materials needed:** The extruder is composed of a metal hopper, a screw, a barrel, a nozzle and a electric powered motor. An electronic box and heating elements are necessary, such as: PID controller for temperature control, SSR switch,

thermocouple, mechanical power switch with indicator and band heater.

If the equipment is built locally, a workspace with a lathe, drill press, welding machine, belt sander and an angle grinder are needed.

As a mold to produce beams, simple metal tubes can be used.

#### **Technical operation & maintenance:**

Temperature testing is required when starting using the extruder. Indicative temperature values for different plastics are: PP 180°C in barrel, 200°C in nozzle; HDPE 190°C in barrel, 210°C in nozzle). Homogenous shredded plastic flakes should be continuously fed into the hopper during extrusion. If a mold is used after the nozzle, make sure to cool down the mold in water before opening it. Regular flushing of extruder after use with virgin material is recommended.

**Health and safety:** It is advised to use the extruder in a well-ventilated area. Consider that the barrel is hot and direct contact may lead to accidental burns. Workers should be equipped with proper personal protective equipment (PPE) with heat proof gloves, work clothes covering arms and legs, safety glasses or face shield to protect from spontaneous ejection of hot substances from the nozzle area.

**Costs:** Material cost for a Precious Plastic design is around 1'300 USD. Full extruder prices on Precious Plastic bazar range from ~2'000 – 6'000 USD.

#### **Social, legal and environmental considerations:**

Toxic fumes can be released during plastic melting, however this can be mitigated with the use of appropriate temperature control equipment. Batches of mixed plastic should not be extruded, as melting plastic at incorrect temperature increases the risk of harmful emissions.

#### **Strengths and weaknesses:**

- ⊕ Continuous output of plastic
- ⊕ Effective plastic recycling technology
- ⊕ Simple to use, once the right settings are defined
- ⊕ Possibility of large variety of output product
- ⊖ Higher-level skills are needed to construct from scratch
- ⊖ Medium-level skill needed to test and set the right temperature

#### **> References and further reading**

1. Precious Plastic, [Build an Extrusion Machine](#), 2022.
2. Precious Plastic, [Set up an Extrusion Work space](#), 2019

 [Precious Plastic – Extrusion starter kit](#)