FINILOOP

plastic waste free cities

From Informal Waste Worker to Plastic Recycling Professional

Training manual on the troubleshooting and maintenance of plastic recycling equipment

WASTE

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IKEA Foundation

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List of key terms

Aggregators	People who buy recyclables from designated places such as households, shops, etc. and sort them further before selling them to bigger aggregators and/or traders. They often use bicycles, tricycles, motorbikes or small vehicles/trucks to transport recyclables (including itinerant waste buyers). Value addition activities such as washing, baling and grinding might be done before selling the end product.
Die	Steel plate with a hole in a specific shape to push molten plastic through and shape it.
Flakes	Small irregularly shaped plastic particles produced by grinding plastic waste material and packaging material.
Flexible plastic waste	Plastic film material/foil – Elastic plastic material that has the ability to stretch, bend or deform without breaking.
Granules/Pellets	Small, regularly shaped and sized particles of plastic that can be used as input for production processes.
Grinder	Machine for size reduction of plastic waste which uses fast spinning blades to cut the material.
Informal Waste Workers (IWWs)	Workers in the waste and recycling sector whose remunerative work (i.e. both self-employment and wage employment) is not registered, regulated, or protected by existing legal or regulatory frameworks, as well as non-remunerative work undertaken in an income-producing enterprise. Informal workers do not have secure employment contracts, workers' benefits, social protection, or workers' representation (including waste pickers).
Personal Protective Equipment (PPE)	Protective equipment such as mouth masks, gloves, safety boots and ear plugs.
Recycler	Person who converts waste materials into new materials and objects.
Screen	A plate with holes to let through only particles of a certain size. Used in a shredder, grinder and extruder.
Shredder	Machine for size reduction of plastic waste. Uses slow moving blades with teeth that slowly rip material apart.
Traders	Wholesalers of specialised materials who sell the sorted recyclable material or intermediate product (bales, flakes, etc) to the recycler.

1. Introduction

FINILOOP (Financial Inclusion and Improved Livelihoods out of Plastics) connects and strengthens actors along the entire waste value and service chain to ensure more effective waste management systems, cleaner environments for all and a more inclusive and transparent circular plastic economy.

This training manual on machinery for recycling of plastic waste has been developed as part of the business development component of FINILOOP. It shows a select number of machines suitable for the valorisation of plastics into products which can be used as intermediate products for the plastics industry or to manufacture final products out of recycled plastic.

The first chapter gives a short explanation on plastics including the types and how they can be recycled or valorised. The following chapters then outline the most important machines used in plastic waste recycling enterprises including their purpose, trouble shooting and safety measures. The final chapter addresses working conditions and the important usage of personal protective equipment.

This manual can be used during workshops to train informal waste workers and enable them to become plastic recycling professionals. To further learning efforts, a series of FINILOOP 'how-to' plastic waste management video tutorials are also available for use.

2.

What are plastics?

Plastics are made of long chain molecules called polymers. These polymers come from hydrocarbons found in coal, natural gas, (organic) oil or natural resources.

There are three main types of plastics:

- **Thermoplastics** can be melted and reshaped many times, making them easy to recycle, and are the most common material in consumer goods and packaging.
- **Thermosets** harden when heated and can't be reshaped or recycled. They are used in specialised applications such as certain construction materials, or industrial parts.
- **Elastomers** are flexible materials that are difficult to recycle, similar to thermosets. Examples of elastomers include rubber and silicone.

Thermoplastics are lightweight, strong, easy to shape, clean, and affordable. Because of these qualities, they are used in many areas like food packaging, cars, farming, and housing. **This manual focuses on thermoplastics,** as they are the easiest to recycle and convert into new products.

2.1 Types of plastics

There are thousands of different types of plastics, each with its own composition and characteristics. Six of these plastics can be easily identified and recycled. The plastics industry has developed a coding system that makes recycling easier. The table below shows these six types of plastics with their codes, general characteristics and usual usage.

Table 1: Types, characteristics and usage of plastics

Identification code	Normal usage	General characteristics	Examples
PET (Polyethylene terephthalate) 	- Bottles for water and soda - (Transparent) food packaging - Clothing such as fleece	- Transparent - Stiff - Strong/tough - Impermeable for gas - Heat resistant - Grease and oil resistant - Shiny/reflective	
HDPE (High-density polyethylene) 	- Bottles and flasks for soap or milk - Buckets and other containers - Film - Crates - Pipes	- Impermeable for water - Resistant against chemical products - Hard or semi-hard - Strong - Surface is soft and waxy - Cheap - Permeable to gas - Often milky white or opaque	

PVC (Polyvinyl chloride) 3 PVC	- Floor tiles - Insulation of electric cables - Pipes for electronics, drainage or irrigation - Soft materials like raincoats - Shoe soles	- Hard, rigid (flexible if plasticised with additives) - Good resistance against chemical products - Stable in the long term - Insulation against electricity - Low gas permeability	
LDPE (Low-density polyethylene) 4 LDPE	- Thin shopping bags - Plastic bags - Film - Pipes	- Tough - Flexible - Waxy surface - Soft, scratches easily - Melts at a low temperature - Stable electrical properties - Barrier for water - Can be stretched out by hand	
PP (Polypropylene) 5 PP	- If soft: Used for bags for food packaging - If hard: Used for consumer products such as drinking cups - Hard food packaging such as yoghurt containers	- Excellent resistance against chemical materials - Stiff but flexible - Strong - Cheap - Cannot be stretched out by hand	
PS (Polystyrene) 6 PS	- Disposable cups for coffee or tea - Packing material (thermocol) - Insulation for houses - Disposable cutlery	- Clear and opaque - Glassy surface - Rigid / Hard - Brittle - High clarity - Affected by grease and solvents - Often foamed up to form an insulating material	
Other types 7 OTHER	- Baby bottles - Car parts - Electrical housing - Multilayer plastics - ABS & PC - Nylon	- Currently hard to recycle - Often has harmful properties - Plastics mixed with other materials	

When working in plastic recycling, you must consider the following:

- For most valorisation and recycling activities it is important to separate the different types of plastics
- You need to avoid littering plastics into nature, rivers and the sea
- The recycling of plastic saves on petrol and energy

Although the production process is similar for all types of plastics, it is important for some businesses to choose only one type to valorise or recycle as each type of plastic requires its own machines with a customised set of blades, temperature regulation and preparing phase.

3.

How to sort plastic waste (with a conveyor belt)

This chapter, together with the following tutorial: How to sort plastic waste with a conveyor belt, can be used during workshops to train informal waste workers and enable them to become plastic recycling professionals.

3.1 Why sorting with a conveyor belt

Plastics come in many different types, and if left unsorted are worth very little. But when separated they can be sold for more money and recycled much more easily.

Although a multitude of methods have been devised to automatically separate plastic, only manual sorting using visual recognition can provide high quality separation at a reasonable cost.

Plastics can be sorted in several ways:

Sorting by category of plastic: In general, the major types of plastics (PET, HDPE, LDPE, PP, PVC, PS) are sorted first. In general, 90% of plastic can be directly recognised based on sorting experience. To make this process quicker, it is important to understand which type of plastic specific products are usually made from. If a product cannot be initially identified the following steps can be taken:

1. Look for a recycling code on the product.
2. PE and PP float in water, other polymers sink. This can be useful for characterising the plastic. Please note: PS that is foamed up, will also float.
3. Holding a piece of material in a flame can tell you a lot about the material.
4. Infrared scanners are available that can identify the material, but they are generally costly.

In general, the major types of plastics (PET, HDPE, LDPE, PP, PVC, PS) are sorted first. The others are stored in a container for future separation if markets for these products exist.

Sorting by colour: this adds more value to the different flows of plastic waste and is one of the easiest ways to sort. It is important to note that recycled plastics have a greyish or brownish colour, which is difficult to sell. Plastic waste should be separated by either its specific colour or tone, for example:

- Light colours
- Whites
- Reds, yellows, oranges
- Browns, blacks, greens
- Blues

Sorting by product: when sorting by material and colour, there can be a lot of variation in the plastic waste. If possible, sort by type of product to obtain a very clean and high value waste stream. This may not be practical for consumer waste but can be an option if industry or restaurants frequently use a specific type of product.

In India plastic waste is often sorted manually by women sitting on the floor placing different categories of plastic in containers (see *Figure 1*).

Figure 1: Manual sorting of plastic waste

Introducing a conveyor belt for sorting has many advantages including:

- **Increased efficiency:** conveyor belts can move plastic waste continuously allowing for more efficient logistics and sorting. Workers stay in one place while the waste comes to them, reducing time spent walking, bending, or lifting.
- **Improved working conditions/reduced physical strain**: manual sorting can be physically demanding. With a conveyor belt, workers can sort in a more ergonomic and stationary position. Less repetitive motion and heavy lifting reduce the risk of injuries.
- **Better workflow organisation:** conveyor systems allow for structured workstations, leading to more organised sorting zones.
- **Improved safety:** workers have less direct contact with sharp, hazardous, or unsanitary materials.
- **Scalability & flexibility**: easier to scale up or improve over time. For example, AI sorting, optical sorters or robotic arms can be added later.

3.2 Trouble shooting and maintenance

When a problem occurs during the operating of a conveyor belt it is important that operators know what to do to solve the problem. The following table shows the most common problems when working with a conveyor belt and possible causes and solutions.

Table 2: Troubleshooting conveyor belt

Problem	Possible Cause	Solution
Unusual noise during operation	- Damaged bearings or rollers - Plastic waste caught in moving parts - Loose components	- Inspect and replace damaged components - Clean system - Tighten loose parts
Material spillage	- Overloaded belt	- Reduce feed rate
Low quality sorting	- Operators require additional training - Conveyor speed too high leaving no time for proper sorting	- Additional education - Reducing the conveyor speed
Conveyor turning the wrong way	- Phases of the motor not connected in the correct way	- Flip the phases
Belt slipping	- Belt tension too low	- Increase belt tension
Belt damaged broken	- Sharp materials amongst waste	- Replace belt

Below you will find a maintenance schedule for conveyor belts handling plastic waste. It outlines daily, weekly, monthly, quarterly and annual tasks to ensure system reliability, prevent breakdowns, and prolong the lifespan of equipment. It is advisable to use a maintenance logbook and provide a checklist for operators to follow daily (see example in *Annex 1*).

Daily maintenance tasks

- Visually inspect belt for damage, wear, or misalignment
- Check for material spillage or jams
- Ensure drive motor sounds normal
- Remove any plastic buildup on rollers and pulleys

Weekly maintenance tasks

- Check and adjust belt tension and tracking
- Clean all components including idlers, pulleys, and belt
- Inspect side guards, hoppers, and chutes for wear or misalignment

Monthly maintenance tasks

- Lubricate bearings, rollers, and drive components
- Inspect and tighten bolts and fasteners
- Check for signs of corrosion or oil leaks
- Test emergency stop and safety switches

Quarterly maintenance tasks

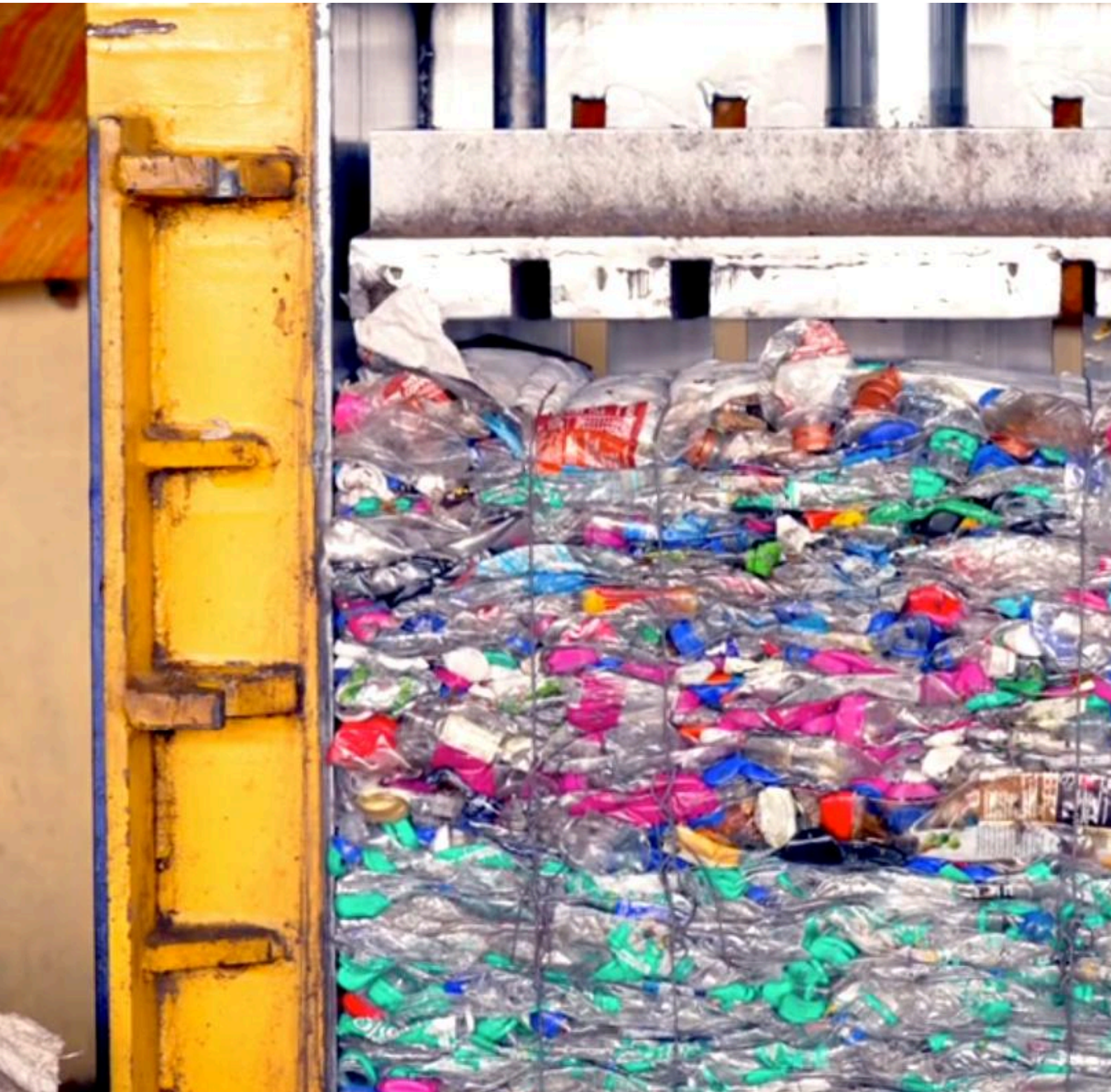
- Conduct motor and gearbox inspection
- Perform belt wear thickness check
- Inspect electrical connections and control panel
- Review logbooks for recurring issues

Annual maintenance tasks

- Perform full system shutdown for deep cleaning and overhaul
- Replace worn belt sections or entire belt if needed
- Update maintenance logs and SOPs
- Train staff on updated safety and maintenance procedure

4.

How to bale plastic waste



This chapter, together with the following tutorial: How to store and pack plastic waste (baling), can be used during workshops to train informal waste workers and enable them to become plastic recycling professionals.

4.1 Why bale plastic waste

Baling involves compressing plastic waste into bales. Baling of plastic waste is recommended when you want to save on storage space and transportation costs as bales take up less space and can be stacked. An increasing number of recyclers are also requiring plastic waste to be baled and are willing to pay a higher price for it.

If you manage plastic waste at a facility or sell plastic waste, baling is a crucial step to make it more efficient, cost-effective, and environmentally responsible.

4.2 Trouble shooting and maintenance

The following table shows the most common problems which can occur when baling, and possible causes and solutions.

Table 3: Troubleshooting baling process

Problem	Possible Cause	Solution
Bale not forming properly	- Uneven loading of material - Overfilling the chamber - Material too loose (e.g., plastic film)	- Distribute material evenly - Avoid overloading - Pre-compress loose plastic or mix with rigid plastics
Baler not starting or powering on	- Power supply issue - Emergency stop engaged - Faulty switch or wiring	- Check power connection and breakers - Reset emergency stop - Inspect electrical components
Hydraulic system not working	- Low hydraulic fluid - Leaking hoses or seals - Pump or motor failure	- Check and refill fluid - Inspect for leaks and replace damaged parts - Check the pressure in the system. Service or replace hydraulic components.
Bale is too loose or falls apart	- Not enough pressure applied - Incorrect cycle timing - Worn press plate or seals	- Increase compression time/pressure - Adjust cycle settings - Replace or service wear parts

Below you will find a maintenance schedule for baling. It outlines daily, weekly, monthly and quarterly tasks to ensure system reliability, prevent breakdowns, and prolong the lifespan of equipment. It is advisable to use a maintenance logbook and provide a checklist for operators to follow daily (see example in *Annex 1*).

Daily maintenance tasks

- Clean the pressing chamber with a broom or vacuum cleaner to remove any dust or unwanted materials
- Check for leaks in the hydraulic system
- Clean the outside of the machine and the floor. A clean machine and surrounding area are important to identify leaks quickly.
- Investigate any unusual vibrations or noises

Weekly maintenance tasks

- Check the fluid levels in the hydraulic system and adjust if required
- Visual inspection of all moving components for wear and connection

Monthly/quarterly maintenance tasks

- Lubricate any moving parts that require lubrication
- Check the electrical wiring for any loose connections or damaged cables. Replace any damaged wiring directly.
- Check any seals and gaskets and replace if required
- Inspect and tighten bolts and fasteners
- Test the safety systems such as the emergency button
- Inspect the hydraulic oil and replace if contaminated

5.
How to grind plastic waste

This chapter, together with the following tutorial: How to grind plastic waste, can be used during workshops to train informal waste workers and enable them to become plastic recycling professionals.

5.1 Why grind plastic waste

A crucial step in recycling plastic waste is grinding. Plastic waste needs to be cut into smaller pieces before it can be processed further. An additional benefit is that the grinded material takes up much less space during storage and reduces transportation costs.

The plastic waste is fed into a grinder and, if necessary, cut into pieces beforehand. The plastic waste should consist of clean objects, selected according to product form, polymer type and colour. These materials are fed into the hopper on top of the grinder. The rotating cutting blades then grind the materials. When the pieces are small enough, they fall through a screen, a plate with holes of a specific size, into the collection tray, or they exit the machine directly. *Figure 5* below shows a schematic overview of the interior of a grinder.

Figure 2: The interior of a grinder

5.2 Trouble shooting and maintenance

The following table shows the most common problems which can occur working with a grinder, and possible causes and solutions.

Table 4: Troubleshooting grinder

Problem	Possible Cause	Solution
Grinder does not start up after connecting to the power supply	- Not all three phases available in the socket - Wrong phase sequence (if equipped with phase detection relay) - Cutting chamber cover not closed completely (safety limit switch is not operated)	- Check phases one by one - Swap phases in socket - Close cutting chamber cover firmly
Blades move in the opposite direction	- Wrong phase sequence (if not equipped with phase detection relay)	- Swap phases in socket
Grinder blocks, jams or shuts off	- Excess scrap material - Any object other than plastic in scrap - Blades are blocked by the screen because it is not secured properly	- Clean grinder, revolve rotor to check for unhindered movement of blade. Reduce amount of material or portions fed to the grinder. - Open grinder to remove foreign object from cutting chamber. Check blade, screen and screen clamp for damage and replace, if necessary. - Position the screen properly and securely
Shredder produces granulate with too much dust content.	- Blades are blunt or damaged - Cutting gap not appropriate - Screen clogged	- Resharpen or replace blade altogether - Check cutting gap and readjust to 0.15mm - Clean or replace screen
Excessive noise	- This may be due to worn-out bearings, misaligned components, or loose parts - Blades are blunt or damaged	- Tighten and replace worn-out parts to reduce noise levels
Overheating/ smoke formation	- Poor ventilation, lack of lubrication, or excessive load can cause the machine to overheat - Blades are blunt or damaged	- Ensure proper lubrication, clean air filters, and operate within the recommended load

Grinder blades

Blades are a vital part of the grinder. For correct operation it is very important that the blades are well adjusted and in good condition. If this is not the case the machine cannot cut the material well. The blades should be sharp and have the right offset.

Blade sharpening: During grinding the blades will slowly wear down and lose their sharpness. Especially when the waste is dirty with sand, this may happen quickly. Blades can be sharpened with the right machinery. It is advised to have at least one set of spare blades so that operations can continue while sharpening the blades. Note that there are blades on the rotor (spinning blade) and blades fixed to the machine (stationary blades). Both need to be sharp.

Blade adjustment: The position of the blades is just as important. There should be a small gap between the stationary blades and the rotor blades. Loosen up the bolts keeping the blades in place and adjust the position. As a rule of thumb make sure the cutting gap is 0.15mm. A practical tip is to use a piece of paper and adjust the blades with a piece between the stationary blade and the fixed blade. Then fixate the blade and remove the paper. Some materials require different gap sizes. Put some material between the blades and manually move the rotor to cut the material. If it doesn't cut properly, adjust the gap.

Below you will find a maintenance schedule for your grinder. It outlines daily, weekly and monthly tasks to ensure system reliability, prevent breakdowns, and prolong the lifespan of equipment. It is advisable to use a maintenance logbook and provide a checklist for operators to follow daily (see example in *Annex 1*).

Daily maintenance tasks:

- **Visual inspection:** Before starting the grinder, check for any visible signs of wear and tear on critical components such as the blades, motor, and feed system.
- **Lubrication:** Ensure that all moving parts are well-lubricated to reduce friction and prevent overheating.
- **Cleaning:** Clear away any plastic residue, dust, or foreign particles to prevent clogging and ensure smooth operation. Cleaning should also always be done when changing material input to prevent contamination.

Weekly maintenance tasks:

- **Blade inspection and sharpening:** The sharpness of the blades is crucial for effective grinding. Blunt blades can cause increased energy consumption and poor grinding quality. Check for nicks and dull edges and sharpen or replace them as needed.
- **Tighten loose bolts and screws:** Due to constant vibrations, bolts and screws may become loose over time. Ensure they are properly tightened to prevent machine misalignment. Marking a line on a tightened bolthead and the machine is a practical way to quickly see if the bolt has come loose.
- **Inspect cooling system**: If your grinder has a cooling mechanism, check for blockages and ensure adequate airflow to prevent overheating.
- **Monitor vibration levels:** Unusual vibrations could indicate alignment issues, wear in rotating parts, or the need for blade replacement.

Monthly/quarterly maintenance tasks

For long-term efficiency, **conduct more in-depth inspections and servicing of your grinder every month or quarter.**

- **Comprehensive cleaning:** Perform a thorough cleaning of internal and external components to remove accumulated debris and plastic buildup.
- **Oil and grease change:** Replace old lubricants with fresh, high-quality grease or oil as per the manufacturer's recommendations.
- **Assess wear on bearings:** Bearings play a critical role in smooth operation. Inspect for signs of excessive wear and replace them if necessary.
- **Evaluate grinding chamber condition**: Over time, the grinding chamber may develop signs of corrosion or damage due to high-intensity use. Addressing such issues early can prevent extensive damage.
- **Test safety features**: Ensure that all safety mechanisms, such as emergency stops and protective covers, are fully operational.

6.
How to wash and dry plastic waste

6.1 Why wash and dry plastic waste

Washing is another crucial step in recycling plastic waste. The presence of impurities can strongly affect the quality of recycled products, and therefore the resale prices.

Washing before grinding: The sorted plastic waste is washed by hand in buckets or basins with cold or warm water. The use of soap or detergent facilitates the task.

Washing after grinding/washing of flakes: This consists of vigorously shaking the grinded plastic flakes in basins of water. The friction between the particles releases dirt. This practice allows a degree of mechanisation. The use of very hot water and powerful cleansing agents such as sodium (or potassium hydroxide) is then possible because the operators are not in direct contact with the materials. It is however necessary to comply with minimum safety rules.

Drying of plastic waste: It is important that plastics are dry before further processing. If not, the material or the machine may be damaged, or operator safety may be compromised. As with washing, plastics can be dried either manually or mechanically. With the manual method the plastics are spread out in the sun to dry and turned regularly.

Mechanic Method: This can be done with a dewatering machine that spins the material in a sieve to remove any moisture, or alternatively by using compressed air or a fan to blow the plastic dry.

Dryers

Some plastics also need to be dried further, such as PET. They contain moisture within the material, so even when it looks dry there can be moisture present. When melting this undried material, the moisture releases causing an unsafe situation and material degradation. Special plastic dryers are available that remove the moisture from the plastic by circulating air through it and removing the moisture from this air. Be sure to perform this step just before further processing because when exposed to air the material will absorb moisture from the air again or, make sure it is stored airtight until further processing

7.

How to extrude plastic waste

This chapter, together with the following tutorial: How to extrude plastic waste, can be used during workshops to train informal waste workers and enable them to become plastic recycling professionals.

7.1 Why extrude plastic waste

Plastic extrusion (from flakes to pellets)

When recycling plastic, cleaned and dried flakes are used as the starting material for extrusion. These flakes can either be directly processed into a product or transformed into pellets first. Pellets are the recommended option as they are more uniform in shape and size and are a well-mixed material ensuring a more stable output.

When processing flakes it is important to carefully feed them into the extruder and ensure they are not too large for the screw. If the flakes are very thin and light, for example flexible plastic foils, they may also struggle to fall into the screw. In this case you can use a hopper to agitate the flakes and help them enter the screw. If the problem is severe, it may be necessary to use an agglomerator to clump the foils together.

Plastic extrusion (from pellets to product)

Plastic extrusion is a process used to shape plastic materials. It starts by feeding small plastic pellets into a machine using gravity. These pellets go into a spinning screw, which moves them forward while heating and melting them.

Once the plastic is melted, it is pushed through a mould called a ‘die’ which forces the plastic into a specific shape which can be of any length with the same cross-section (shape when cut across).

During this process, the plastic changes from a solid to liquid and back to solid again—without losing its key properties.

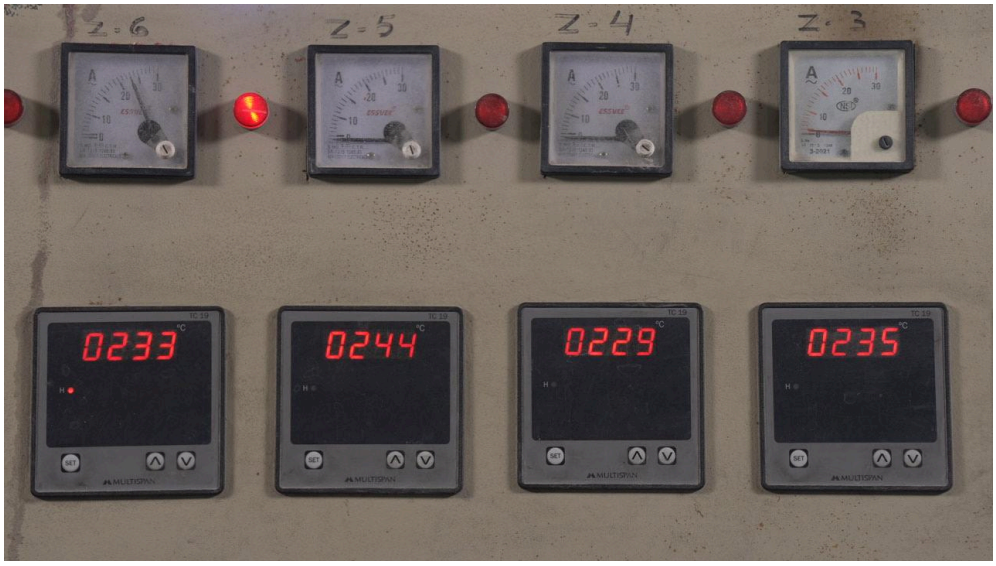


Figure 3: Temperature range of extruder compartments

7.2 Trouble shooting and maintenance

The following table shows the most common problems which can occur working with an extruder, and possible causes and solutions.

Table 5: Troubleshooting extruder

Problem	Possible causes	Solutions
Inconsistent output flow	- Fluctuating feed rate - Material blockage - Worn screw or barrel - Incorrect temperature profile	- Ensure consistent feeding system - Clean hopper and screw - Replace worn screw or barrel - Set the correct temperature profile. As a rule of thumb: The last zone should be the processing temperature of the plastic, then each zone before it should be 10°C per zone.
Poor material melting	- Incorrect temperature settings - Heater malfunction - Wrong RPM - Start-up behaviour - Material contamination	- Adjust barrel temperature - Check and replace faulty heaters - Optimise screw speed - Wait until a constant process is achieved and material melts properly - If the input is contaminated with different types of plastic, these might not fully melt. Ensure a clean input stream.
Excessive vibration or noise	- Worn bearings or motor issues - Loose components	- Inspect and replace bearings - Tighten all mechanical connections.
Burnt plastic/discoloration	- Overheating - Long dwell time - Contaminated feedstock	- Reduce temperature - Ensure steady throughput - Use clean, sorted plastic
Back pressure too high	- Dirty screen pack - Clogged die - Wrong screw design	- Clean or replace screen and die - Review and modify screw configuration - Each material comes with a specific screw
Low output rate	- Low screw speed - Worn barrel/screw - Cold zones in barrel - Clogged screen	- Increase RPM - Replace worn parts - Check heater bands and thermocouples - Remove and clean the screen
Inconsistent intake (and therefore output)	- Material too large for screw	- Reduce the size of the inlet material - Carefully agitate the material with a plastic stick or, change input

	- Bridging: material stuck in hopper. This can happen with thin flakes. - Inlet too hot	material if this happens continuously - The inlet should be cooled; plastic should not be molten here. Check the cooling ring or adjust machine settings.
Clogged die	- Material solidifies in die - Contaminations in die	- Increase the temperature of the die, or heat it with a torch to loosen up solidified material - Open the die and clean out any contaminants - Add a screen (or reduce screen hole size if one is already installed) if the die is clogged often

Below you will find a maintenance schedule for your extruder. It outlines daily, weekly and monthly tasks to ensure system reliability, prevent breakdowns, and prolong the lifespan of equipment. It is advisable to use a maintenance logbook and provide a checklist for operators to follow daily (see example in *Annex 1*).

Daily maintenance tasks:

- Inspect hopper, screw, and barrel for material buildup or blockages
- Check for any unusual noises, vibrations, or leaks
- Clean feed zone, hopper, and surroundings to prevent contamination
- Verify temperature settings and heater functionality
- Monitor pressure gauges and motor performance
- Lubricate moving parts if applicable
- Ensure emergency stops and safety devices are operational
- Check screen pack for clogging or pressure increase
- Log production parameters and any irregularities

Weekly maintenance tasks:

- Inspect and clean the die and screen changer thoroughly
- Check electrical connections and sensor calibrations
- Examine screw wear and barrel condition for early signs of degradation (only when you notice something is wrong)
- Drain and clean any water-cooling systems (if equipped)
- Inspect motor belts, couplings, and gearbox (if accessible)
- Check hopper loader and feeding systems for dust or plastic residue

Monthly maintenance tasks:

- Conduct full inspection of screw, barrel, heaters, and thermocouples
- Replace screen packs and filters (even if not fully clogged). Screens can be cleaned in an oven by burning off any material.
- Tighten all bolts, flanges, and frame structures

- Test control panel functions and alarms
- Lubricate gearboxes and bearings according to manufacturer’s specs
- Review wear patterns on screw and die for possible reconditioning
- Perform electrical system check for grounding and insulation wear
- Update maintenance logs and plan preventive maintenance

8.
Working conditions/safety issues

8.1 Personal Protective Equipment (PPE)

To ensure you remain fit enough to physically run your business it is vital to pay attention to your personal protective equipment (PPE) when recovering and treating waste.

Why is it important?

- You lower the risk of falling sick or becoming infected by malaria, tuberculosis, HIV etc
- You save costs (direct and indirect) caused by accidents
- You increase your productivity by not missing time at work due to poor health
- You present a more professional picture of yourself and your company to the outside world

The following picture shows the basic equipment you should wear when waste picking and collecting:

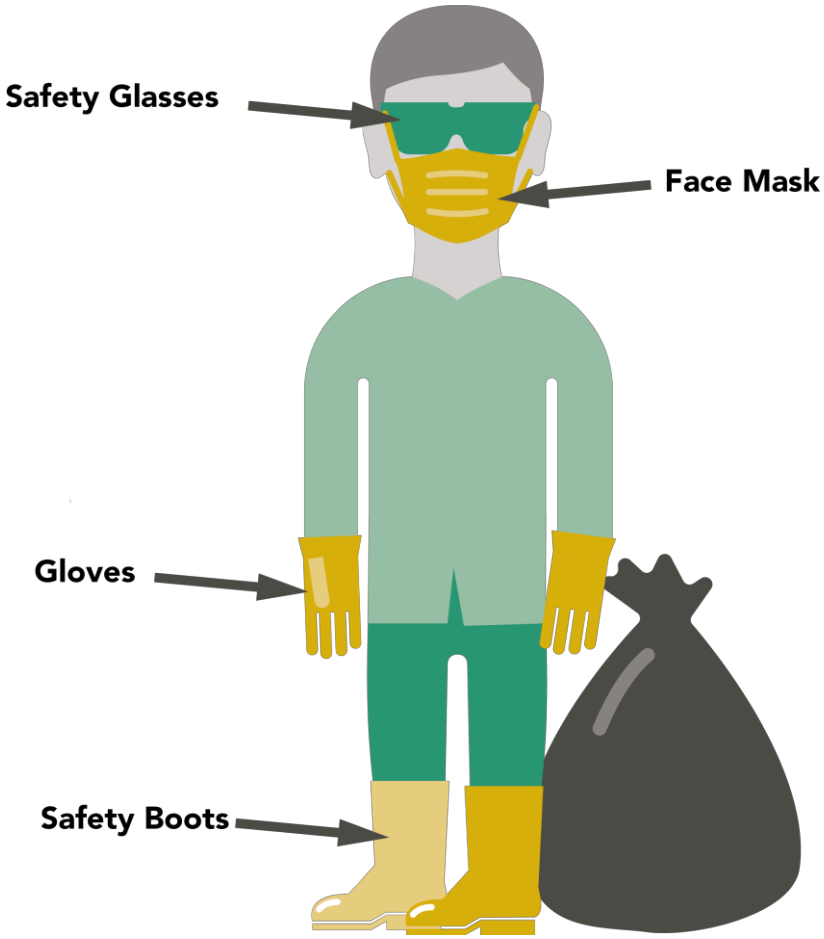


Figure 4: Full PPE gear needed for working safely with waste

Gloves

Gloves will help protect your fingers, hands, wrists, forearms, elbows and arms from:

- Injuries
- Cuts
- Contact with other aggressive contaminants or pathogens, such as faeces, syringes, dry sex litter, car batteries etc.

Mask

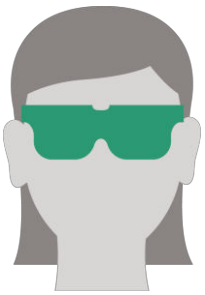
A mask will help protect your airways from:

- Breathing in toxic substances (when using a special mask with a filter) or hazardous liquids such as paint, varnishes and other cleaning products
- Breathing in smoke from burning waste

Safety glasses

Safety glasses will protect your eyes from:

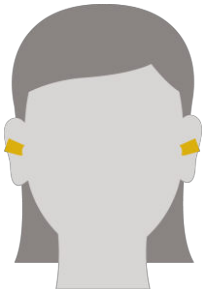
- Splashes from hazardous materials
- Smoke from burning waste
- Pieces of glass or plastic entering your eyes during size reduction activities



Earplugs

Earplugs prevent hearing damage by protecting you from:

- Sudden high-volume noises
- Long term exposure to moderate noise, such as in a factory

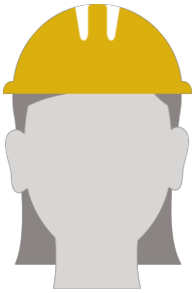


Helmet

Whenever working in an environment where material might drop from above, a helmet is required to prevent:

- Severe damage to the head if something drops

If something falls onto a helmet or it drops to the floor it can be damaged, even if this is not visible, it should be replaced.

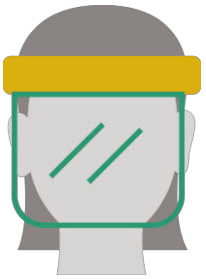


Boots/safety shoes

Safety boots will protect your feet, ankles and legs from:

- Injuries caused by broken glass or other sharp items
- Infections caused by syringes
- Contact with other dangerous contaminants
- Heavy material dropping on your toes

Face shield:



A face shield is required when there is a risk of material flying into your face. It is more protective than a pair of safety glasses and should be used:

- When working with molten plastic under pressure (in an extruder)
- When there is a risk of solid material flying into your face

9.

Safety and good housekeeping around the machines

Most machines need regular maintenance. As plastic waste is often polluted with sand and metal, plastic waste processing machinery requires even more attention. Both sand and metal can be harmful to the blades or turning elements of a machine. Water on plastic waste can also cause sudden explosions in the hot machines. Therefore, it is important to make sure that plastic waste is as clean and dry as possible.

Tips to improve maintenance:

- Thoroughly wash and dry the plastics you will be using
- Add a magnet to fish out steel particles
- Check your machine after each production day and clean it regularly
- Make sure you have an emergency button to be able to cut electricity immediately
- Have at least one fire extinguisher suitable for fires from plastics & electricity
- Make daily project reports on production & functioning of the machine
- Clean the machine and their surroundings daily
- Turn off the machine or detach it from the power supply, if possible, while repairing or carrying out maintenance

Figure 5: Essential safety equipment when working with recycling equipment

Annex 1: Example of a maintenance log

Equipment Maintenance Log

Equipment description: _____

Serial Number: _____ Model Number: _____

Date:	Action Taken/Comments:	Initials

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