Foreword

This Bangladesh standard was adopted by the Bangladesh Standards and Testing Institution on ....., after finalized by the Rubber and Plastics Sectional Committee had been approved by the Chemical Divisional Committee.

Recycling/Reprocessing of plastics waste/scrap is not new to Bangladesh. The Bangladeshi processors are already collecting the plastics waste/scrap of all sorts and converting into pellets for re-use. Need for recycling/ reprocessing of plastics became more relevant with increase in the plastics consumption and also with availability of waste/scrap plastics in huge quantities.

The methods of recycling and the technology used for the same at present are quite outmoded and are in need of upgradation. It has also been observed that some of the industries even recycle the plastics waste/scrap which is totally unhygienic and as such is a health hazard for persons who use items made from such plastics and even used at times for packaging of foodstuff and medicines.

Plastics waste/scrap also occurs in the commingled form and has, therefore, to be segregated before being recycled/ reprocessed. It is essential to segregate the plastics waste/ scrap fully and not to attempt reprocessing of commingled plastics waste/ scrap without appropriate technologies. These considerations led the committee to formulate these guidelines for recycling/ reprocessing of plastics.

In the preparation of this standard, considerable assistance has been taken from the following standards:

IS 14534:2022 Guideline for recycling of plastics; Bureau of Indian Standards.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value (Observed or calculated) expressing the result of a test or analysis when applicable, shall be rounded off in accordance with BDS 103.

Bangladesh Standard

Plastics - Guidelines for the Recovery and Recycling of Plastics Waste

1.0 Scope

1.1 This standard prescribes guidelines for the recycling of plastics waste/scrap by different techniques based on technological trends and policy directives issued for the plastics waste management in Bangladesh. The process stages, requirements, recommendations and terminology presented in this standard are intended to be for general applicability. The scope of this standard does not cover product related specifications or requirements including statutory guidelines, issued from time to time and as applicable.

1.2 The guidelines shall help manufacturers of plastic products who wish to use recycled material along with virgin material in deciding about quality and marking requirements based on percentage of recycled content used in the finished product.

2.0 Normative References

The following standards are necessary adjuncts for this standard. For undated reference latest edition may be used.

Standard	Title
ISO 472	Plastics — Vocabulary.
ISO 14021	Environmental labels and declarations — Self-declared environmental claims (Type II environmental labelling).
ISO 22095	Chain of custody — General terminology and models.
ISO 1043-2	Plastics — Symbols and abbreviated terms — Part 2: Fillers and reinforcing materials.
ISO 1043-3	Plastics — Symbols and abbreviated terms — Part 3 : Plasticizers.
ISO/DIS 5677	Testing and characterization of mechanically recycled Polypropylene (PP) and Polyethylene (PE) for intended use in different plastics processing techniques.
EN 15343	Plastics — Recycled Plastics — Plastics recycling traceability and assessment of conformity and recycled content.
BDS EN 14023	Bitumen and bituminous binders - Framework specification for polymer modified bitumens.

3.0 Terminology

For the purposes of this document, the terms and definitions given in ISO 472 shall apply, in addition to the terms listed in Annexure A. As required, environmental terms related to the scope of this document, being developed under standardization activity of ISO TC 61/ SC 14 may also be referred.

4.0 Source

Plastics material for recovery and /or recycling may be obtained from various sources, including the following:

4.1 Pre-Consumer Sources of Materials

4.1.1 Plastics producers

- floor sweeping, start-up, machine waste, long-ends and any such process waste which are not processable into a finished product

4.1.2 Plastics processors

- processing purge material and scrap;
- scrap products, parts and semi-finished products.

4.1.3 Others

- industrial and commercial products made of, or containing, plastics, including packaging and containers.

4.2 Post-Consumer Sources of Materials

4.2.1 Disposables

- personal goods,
- type of packaging materials, products woven and non-woven products.

NOTE — Such disposables may be recovered by sorted municipal collection systems or by specific consumer incentive systems on containers or by any other organized/unorganized individual or group of individuals for economic benefits. As per Department of Environment (DoE), Ministry of Environment, Forest and Climate Change, Government of Bangladesh notifications issued from time to time, Brand owners, plastics packaging producers, importers of plastics products, Plastics Waste processors are also required to organize collection of plastics waste directly or in association with local authorities or other organizations for its recycling as per Standard Operating Procedure (SoP) notified by Government of Bangladesh.

4.2.2 Durable Goods

- domestic appliances, utensils, upholsteries, carpets, curtains and covers etc.;
- electronic / electrical equipment's;
- automotive and transportation equipment's;
- construction products;
- industrial equipment's;
- household items;
- agricultural products; and
- building and construction products.

NOTE — End-of-life products such as electronic equipment or automobiles may be returned by the consumer to specialized operators for recovery. Similarly, during building demolition operations, plastics materials and products may be segregated and recovered.

5. Recovery

5.1 General

Selection of the appropriate recovery option will depend on many factors, such as segregation, quality / type and design of the plastic product, quantity and availability of the plastics waste, the availability and capability of existing technologies and equipment and the relevant recovery targets in terms of material or energy content requirements. When the target is disposal of the waste, compliance of emissions and other relevant environmental norms specified by the regulatory authorities, is to be ensured. Relevant selection criteria include the relative costs, competitiveness and environmental performance of the available options (see Annex B). Access to markets for recovered materials or energy is an important consideration.

NOTE — Concepts and definitions of recovery are continually evolving. The basic principle of recovery lies in the transformation of an input (waste) into an output (product). Recovery is complete when secondary materials, fuels or products have been manufactured, or energy has been generated, in accordance with consensus- standardized criteria. Plastics recyclates with specified properties (secondary raw material) is a product, and recovery is accomplished when this product has been produced and has become commercially available, or energy has been generated (see Annex B and Annex C).

5.2 Material Recovery

5.2.1 General

Material recovery of plastics waste encompasses three distinct recycling routes: mechanical recycling, feedstock or chemical recycling and biological or organic recycling.

5.2.2 Mechanical Recycling

5.2.2.1 Sequence of operations

5.2.2.1.1 The mechanical recycling option generally comprises of the following sequence of operations, some of which may occur simultaneously, that are carried out as part of the recyclate preparation and production process:

Collection ⟶ identification ⟶ sorting/separating (into types and forms of plastic) ⟶ Grinding shredding ⟶ washing ⟶ drying ⟶ agglomerating/mixing ⟶ extruding /compounding ⟶ pelletizing

5.2.2.1.2 Over the years, technology and machinery for mechanical recycling have significantly improved with automation, process control, higher output to produce good quality of recyclates, which can be used in plastics processing or product manufacturing techniques.

NOTE —

1. In practice, many plastics processors or recyclers use plastics recyclates in the form of flake, eliminating the need for a prior pelletization step.
2. Plastics waste of all categories of plastics packaging as defined in DoE notification need to be effectively sorted, washed and cleaned by utilizing appropriate machinery and equipment.
3. Plastics waste for mechanical recycling may be offered in the form of bulk waste as collected, or in a value-added grade such as sorted, cleaned, standardized for weight etc.
4. For testing and characterization of mechanically recycled polyethylene (PE) and polypropylene (PP), relevant BDS or ISO standard (ISO/DIS 5677) shall be used.

5. For recycling of waste from engineering plastics (ABS, PC, Nylon variants), PVC, PET and all other plastics including mixed waste recycling, proven technology of machinery and processes from Bangladesh or outside Bangladesh shall be used to produce processable recycled material in conventional plastics processing, as applicable for products with desired specification.

5.2.2.2 Pre-treatment

Depending on the intended application of the recyclate and the characteristics of the waste stream, a preparatory step may be used to decontaminate the collected material, as far as practically possible and to optimize their handling characteristics for shipping, processing and other downstream operations.

In the absence of homogeneous plastics waste consisting of materials of similar grade or type, material identification, sorting and separation steps become critical, such as in specialized sorting, washing and cleaning for household packaging or end-of-life electrical and electronic equipment.

Wherever possible, these pre-selective operational steps should be carried out prior to any downstream mixing (commingling) with other waste streams. In some cases, particularly affecting post-consumer sources and at higher quantity operation level, attainment of this objective may require automated separation and sorting unit operations. In the absence of such automatic process control, precise identification of the sources of the components of the waste may be of crucial importance.

NOTE — In order to optimize the recovery efficiency of plastics products and component parts, it is desirable to design for ease of disassembly and material identification as well as for minimization of variety in the types of plastic used in their manufacture. Such criteria may evolve as a function of the future development and implementation of technical options for resource recovery.

5.2.2.2.1 Identification

5.2.2.2.1.1 The implementation of product identification code on both rigid and flexible plastics products facilitate in mode of separating materials, by type of plastics, at any point in the process, including the post-consumer stage, during manual or automatic sorting at the collection facility, and during disassembly of durable goods. With known and regular source of waste and with the involvement of experienced manual operators, identification in local level / decentralized segregation systems achieve the desired level of efficiency.

5.2.2.2.1.2 For large scale operation, various in-line analytical methods using techniques such as infrared analysis and trace-element tracking are available for the identification of specific types of plastic and associated additives, thus permitting their efficient downstream separation and segregation.

NOTE — In case of unknown or new source material, polymer characterization of waste should be carried out for identification of input waste by Differential Scanning Calorimetry (DSC), Fourier Transform Infrared (FTIR) or Chemical analysis in laboratory.

5.2.2.2.2 Separation and sorting

Plastics separation and sorting operations, which are generally required in all material recovery processes, may be carried out manually or automatically or combination of both systems using appropriate means of identification. The more accurate and efficient the means of identification,

sorting and separation, the better is the quality of the recovered product obtained. Depending on specific circumstances, a compaction process such as crushing or baling to reduce size may be necessary to ensure easier handling. In manual sorting, risk of chemical, microbiological and ergonomic problems due to repetitive work can appear. Therefore, if manual sorting cannot be avoided, the workplace shall be designed to minimize such problems.

NOTES:

1. Pre-consumer products can generally be sorted by type of plastic to permit their re-use in the production process. Re-use of post-consumer products is generally rendered more complex because of their contamination by adventitious heterogeneous plastics waste.

2. Some post-consumer materials may consist of plastics fractions with different material properties such as different melt flow rates, densities or colours. Separation of the waste according to their colour, flow rate is very important for achieving high quality recyclate. In some cases, it may not be practically or commercially viable to achieve the desired levels of separation or cleanliness. In such cases these inputs should preferably be diverted for alternative recovery process like mixed waste recycling or feedstock / chemical recycling. If the input plastics waste is commingled, choice of recycling process should be carefully made.

3. Recycling of reinforced plastics may be carried out in some cases without separating the polymeric matrix from fibre reinforcements. When sufficiently efficient separation, as required for the desired property profile of the recyclate, is not feasible at the preparatory process stage, appropriate preliminary operations should be conducted at the next regenerating step.

5.2.2.3 Recyclates production process

5.2.2.3.1 The commercial production of plastics recyclates or granules or pellets through mechanical recycling comprises sequence of operations, including the separation of materials, efficient removal of contaminants by washing or other methods, drying where appropriate, handling, constitution of lots, storage, packaging and shipment. In addition, other processes, such as grinding, additional sorting, homogenizing, extruding, pelletizing, micronizing or dissolution in solvent, may be necessary in order to regenerate the plastics material.

5.2.2.3.2 Recyclates are usually conditioned as agglomerate or regrind in the form of fluff, flake, chips, pellets or powder. Addition of modifiers or stabilizers may also be carried out in order to enhance the value of recyclates for subsequent use.

NOTE — All separated contaminants, such as those entrained in waste water, should be taken into account and handled properly during these preparatory steps.

5.2.2.4 Use of plastics waste in partial substitution of bitumen for asphalt road construction

5.2.2.4.1 Use of plastics waste in partial replacement of bitumen for the construction of asphalt road has multiple benefits: improvement of the quality of the road, reduction of cost and scientific disposal of otherwise abandoned plastics waste — especially flexible plastics waste.

5.2.2.4.2 Plastics waste blended bitumen road offer better binding property, higher softening point, ability to withstand higher temperature, lower penetration value, higher Marshal Stability

value-resulting in increased strength of the road and better water resistance. All these benefits lead to longer life of the road and that too at reduced cost.

5.2.2.4.3 Types and size of plastics waste and the mixing process have been described in BDS EN 14023.

5.2.3 Feedstock or Chemical Recycling

5.2.3.1 Using various processes, well-known within the petrochemical industry, plastics can be depolymerized by pyrolysis process and fed back into the cracking process to form into their basic monomeric chemical constituents or into hydrocarbon fractions. These chemicals can then be used either as polymerization feedstock or in other useful applications and chemical processes.

5.2.3.2 Waste generated out of mixed plastics, commingled plastics and plastics materials made out of a combination of different plastic materials are generally difficult for normal recycling (mechanical recycling). This technology helps decentralised recycling process in urban localities without creating any environmental pollution.

5.2.3.3 Mixed plastics including thermosetting plastics can be converted into LDO (Light Diesel Oil) range of oil having useful applications. Evolved methane gas can be trapped and be used to produce electricity or be used as gaseous fuel.

NOTES:

1. The depolymerization technique has already been demonstrated, for Example: PET obtained from post-consumer packaging sources such as collected commingled plastic bottles where the PET is sorted and subsequently depolymerized, generating monomer feedstock for polymerization and the subsequent manufacture of products such as bottles and fibres. In the case of some acrylic polymers, such as methyl methacrylate, monomer obtained by depolymerization also provides feedstock for commercial polymerization processes.

2. Reducing Agent in Blast furnace for production of iron: Waste plastics are used as reducing agent in the blast furnace for the manufacture of iron from its ore. Use of coke in the blast furnace provides only one type of reducing agent – Carbon Mono-oxide (CO). In contrast, use of plastics waste provides one additional reducing agent – Hydrogen (H) apart from Carbon Mono-oxide. The process also reduces generation of 'ash'.

5.2.4 Biological or Organic Recycling

Biodegradation is a viable option for the treatment of certain types of plastics waste in what is referred to as organic or biological recycling. Such plastics may be treated by aerobic or anaerobic decomposition processes, after collection and separation of non-biodegradable materials. Biodegradable / organic waste content inside such compostable plastics bags, need to be separated from the compostable plastic bags because organic wastes decompose within few days / weeks in the open environment, whereas compostable plastics start decomposing only after few months in industrial composting conditions. During this period, organic wastes do not get proper condition for decomposition causing uncertain / undesirable environmental conditions. In the context of mechanical recycling, however, such plastics may themselves constitute contaminants if they are likely to be subjected to thermal degradation and decomposition at the prevailing recycling operating temperature.

5.3 Energy Recovery

5.3.1 Energy recovery is a viable option for consideration with plastics materials in the same way as the other recovery options discussed in this Standard. The direct combustion or co-combustion of plastics wastes in systems such as Plasma Pyrolysis Technology (PPT), municipal solid-waste incinerators operating in compliance with regulatory requirements for emissions and ash are notable examples of energy recovery.

5.3.2 Co-Processing in Cement Kilns: One of the most effective methods of recycling of plastics waste for recovery of energy is its use as an alternative fuel in cement kilns. The high temperature used in the cement kilns gives a scope for use of some types of plastics waste contaminated with toxic chemicals like pesticides and some other hazardous materials without creating any increased emissions in the air or water. All types of plastics without segregation or proper cleaning can be fed after necessary resizing process (usually done at the cement kiln site).

NOTE — Since most plastics waste is hydrocarbon in nature, it possesses an inherently high calorific value. Because of this, the final utilization of the recovered plastics stream as a fuel can be very effective, provided that adequate attention is given to the control of factors such as combustion by-products. This is demonstrated by the successful application of this recovery option in industrial processes and systems for steam generation, in electricity cogeneration as well as in lime and cement kilns.

6.0 Quality Requirements

6.1 General

Selection of any one of the available recycling options should be based on compliance with the following requirements:

a) to minimize adverse environmental impact;

b) to enhance the circular recycling of plastics;

c) prior demonstration of sustainable commercial viability;

d) secure access to viable systems for collection and quality control; and

e) access to appropriate recycling technologies, if recyclates are intended to be used in food contact material, as per guidelines issued from time to time.

NOTE — A suitable traceability system for the target market may be set up based on appropriate standards from the ISO 9000 and ISO 14000 series. If relevant, provisions of ISO 14021 concerning self-declared environmental claims should also be met.

6.2 Contamination

6.2.1 Contaminants in recyclates may be polymeric in nature (for example the inclusion of different polymers or of different grades and compounds of the same polymer) or non-polymeric (for Example: the presence in the original polymers of various functional additives, fillers and reinforcing materials such as are defined in ISO 1043-2 and ISO 1043-3). They may also be undefined as in the case of adventitious contaminants such as labels, label inks, closures, metal inserts, foreign matter including dirt and residual contents of plastics containers or packaging.

NOTES:

1. Relevant information about composition, additives, colorants, fillers and reinforcing materials are also summarized in the material designation in ISO standards. Excessive levels of contamination may degrade the quality of recyclates to the extent of rendering the recovered materials useless because of problems such as deterioration of their physical properties, incompatibility and unacceptability of odour. Contamination levels may be minimized by the following:

- clear identification and efficient sorting of materials and products;
- careful handling in the collection, separation and sorting phases;
- effective separation and super cleaning washing processes;
- magnetic separation of metal parts; and
- the use of melt filtering or other filtering systems, where appropriate.

2. In some cases, contaminants, if present in airborne dust for example, may necessitate special treatment during recovery operations in order to ensure observance of industrial health and safety requirements.

3. When the recyclate is intended to be used in food contact material, the process and end material should comply to relevant regulatory requirement such as the guidelines issued by relevant regulatory body of Bangladesh.

6.3 Visual and Aesthetic Aspects

6.3.1 In most cases, provided adequate controls and good manufacturing practices are employed, visual and aesthetic properties such as colour, transparency and cleanliness should be provided when dealing with recyclate generated from industrial sources of pre-consumer material.

6.3.2 In the case of recovered material obtained from post-consumer sources, however, visual and aesthetic aspects often present major difficulties, especially when the recovered materials or products consist of a wide variety of containers and disposables from diverse sources and applications. However, if such post-consumer sourced material is segregated before the process of recycling based on the colour, transparency and cleanliness, the aesthetics of resultant recyclates may become relatively easier.

6.4 Properties of Recyclates

6.4.1 The properties of plastics recyclate may be affected by previous exposure to a wide variety of service environments as well as by other factors such as the presence of contaminants, and chemical or structural changes occurring during processing and recycling.

6.4.2 Application of proper sorting techniques, advanced cleaning techniques, minimization of contaminant levels as well as the observance of appropriate recovery practices will minimize adverse effects on the properties of the recyclate. When the recyclate is intended to be used in food contact material, the decontamination process employed must be capable of removing the contaminants and migrants as specified by the regulatory agencies. To achieve this, only approved recycling processes as notified by regulatory bodies of Governmental of Bangladesh should be employed in such recycling.

6.4.3 Further, the properties of the recyclates may be monitored by conducting tests appropriate to the requirements of the intended application. Specific material properties of plastics

recyclates may be enhanced by the addition of property-modifying additives, including virgin plastics material. Any compounded additives and virgin plastic material that were added and are present should be disclosed in material specifications as well as in the material safety data sheets required by the regulator.

6.5 Criteria for Acceptance

The criteria for the acceptance of recyclate for a specific application are governed by the requirements of the application and by the agreement between the supplier and the user. These may include information such as:

a) proper identification, including the batch numbers of the identified polymer;

b) data on additives, fillers, colours and pigments, if any, reinforcements and composition, such as the nature and concentration of contaminants and the content of identified polymers and recyclates;

c) mechanical, physical and chemical properties and packaging requirements; and

d) for recyclates that is proposed to be used in food contact applications, must qualify to Standards / Regulations prescribed by Government Authorities from time to time, to address any potential food and health safety issue.

NOTE — The performance-based properties of specified recyclates will have to satisfy the requirements of any specific product application. This requirement is of critical importance in order to promote and develop the use of recycled plastics.

7.0 Guidelines for Marking

7.1 This prescribes guidelines to the manufacturers of plastic products with regard to the marking to be used on the finished product in order to facilitate identification of the basic raw material. It will also help in identifying whether the material used on the end product is virgin, recyclate or a blend of virgin and recyclate.

7.2 Identification Marking

7.2.1 The manufacturers of plastics end products from either virgin or recycled plastics shall mark the symbol at the time of processing in order to help the re-processors to identify the basic raw material. The symbols are as follows:

NOTE — PET — Polyethylene terephthalate, HDPE — High density polyethylene, V — Vinyl (PVC), LDPE — Low density polyethylene, PP — Polypropylene, PS — Polystyrene and OTHER means all other resins and multi-materials, like ABS (Acrylonitrile butadiene styrene), PPO (Polyphenylene oxide), PC (Polycarbonate), PBT (Polybutylene terephthalate), etc.

While marking the symbol 7, the name of respective basic raw material like ABS, PPO, PC, PBT, etc., and any blend or alloy shall be indicated below the symbol.

7.2.2 In addition to the symbol indicated at 7.2.1, the product made from recycled/reprocessed plastics/regranulated plastics should be marked with appropriate symbol or marking of

percentage of recycled material used based on certification of recycled content as per procedure given in this document (Example: The product containing 25 percent shall be marked with R25).

Audit and certification of manufacturing facilities shall be required for traceability or use of specified percent of recycled content in the production of plastic products to claim their recycled content and use the above Codification.

Traceability of the material in different process steps must be verified throughout the whole chain of custody of the material in order to make a claim of recycled content in final products. Available ISO and EN Standards shall be specifically referred for the Audit, as referred in this document to certify the recycled content by BSTI.

NOTE — ISO 22095 and EN 15343 may be referred for traceability of the material and chain of custody respectively.

7.3 To prevent pollution, appropriate measures shall be taken to dispose of the effluent and emission generated as a result of any operation of recycling and the provision of Bangladesh Environment Conservation Rules 1997 and any Rules framed thereunder shall be complied.

7.4 Variants of all types of Degradable polymers (Biodegradable, Compostable or other degradable products) shall not be mixed with normal plastics for recycling. Such plastics shall be segregated and isolated before recycling.

Identification of degradable plastics – Waste plastic collectors may not be able to identify degradable (PLA, PBAT, PHAs etc.) and non-degradable polymeric products unless they are appropriately labeled. Hence, it is necessary to suitably identify the product or article with label or marking, "bio-degradable" or "compostable", as the case may be, for the products made with such type of plastics as per guidelines issued from time to time.

7.5 A typical suggested end-products using appropriate types of recycled/reprocessed plastics waste/scrap is as follows:

Sl. No.	Product	Material
a)	Trash/Garbage bags	PE
b)	Carry bags	PE
c)	Office supplies - File folders, binder covers, presentation folders, etc.	PVC, PE, PP
d)	Containers for detergents, petroleum products, pallets, including reusable packaging containers	PE, PP, PS, PET
e)	Containers for eggs, fruits and vegetable	PE, PP, PS, PET
f)	Horticultural supplies — Planters, trays, flowerpots, nursery bags. tarpaulin	PE, PVC, PP PS
g)	Building products — Wood substitute such as fencing, shingles, etc.	PS, PVC, PC
h)	Municipal supplies — Garbage bins, wheel burrows, etc.	PE, PP
i)	Carpets and floor mats, playground equipment's, jacket, T-shirts, sports-wear, geo-textiles, tool handles, footwear, luggage, etc.	PE, PP, PET, PS
j)	Recreational equipment — Garden furniture, etc.,	PE, PP
k)	Twine (Sutli), box strapping for packaging	PP, PE, Nylon
l)	Pipes and fittings for cable, ducts/conduits SWR, drainage, agricultural	PVC, PE, PP
m)	Shoes, Chappals	PVC
n)	Film, sheet	PET, PVC, PE, PP
o)	Furniture (Kitchen, shoe rack, wardrobes etc.)	PET

NOTE — Product Applications as Food Contact Material, Pharmaceutical, and Cosmetics shall be governed by prevailing regulatory directives and applicable national standards.

Annex A

(Clause 3)

A-1 Aerobic Biodegradation — Biodegradation under aerobic conditions.

A-2 Agglomerate — Shredded and/or granulated plastics material in the form of particles which cling together.

A-3 Anaerobic Biodegradation — Biodegradation under anaerobic conditions.

A-4 Anaerobic digestion — Biological conversion of biodegradable materials by micro-organisms in the absence of oxygen creating two main products: biogas and digestate.

A-5 Baling — Process in which plastics waste is compacted and secured as a bundle to facilitate handling, storage and transportation.

A-6 Batch — Quantity of material regarded as a single unit and having a unique reference.

A-7 Bio-Based Plastic — Plastic partly or wholly derived from biomass.

A-8 Biodegradation — Degradation caused by biological activity, especially by enzymatic action, leading to a significant change in the chemical structure of a material.

A-9 Biological Recycling — Aerobic (composting) or anaerobic (digestion) treatment of biodegradable plastics waste under controlled conditions using micro-organisms to produce, in the presence of oxygen, stabilized organic residues, carbon dioxide and water or, in the absence of oxygen, stabilized organic residues, methane, carbon dioxide and water.

A-10 Blow moulding — Manufacturing process of forming a molten tube (parison or preform) of thermoplastic material and placing it within a mould cavity and inflating the tube with compressed air, to take the shape of the cavity and cool the part before removing from the mould.

A-11 Blown film extrusion — Manufacturing process that involves extruding a tube of molten polymer through a die and inflating it to several times its initial diameter to form a thin film bubble which is then collapsed and used as a lay-flat film.

A-12 By-product — Co-product from a process that is incidental or not intentionally produced and which cannot be avoided.

A-13 Calender — Machine that has a series of heated rolls, arranged in pairs, the rolls in each pair turning in opposite directions.

A-14 Catalyst — Substance used in small proportion, that augments the rate of a chemical reaction, and in theory remains unchanged chemically at the end of the reaction.

A-15 Chemical Recycling — Conversion to monomer or production of new raw materials by changing the chemical structure of plastics waste through cracking, gasification or depolymerization, excluding energy recovery and incineration.

A-16 Circular Economy — A circular economy aims to maintain the value of products, materials, and resources for as long as possible by returning them into the product cycle at the end of their use, while minimizing the generation of waste.

A-17 Closed loop recycling — process in which post-consumer or industrial waste is collected and recycled preserving the value of the material so it can be used again to make the same product category it came from with minimal loss of quality or function.

A-18 Collection — Logistical process of moving plastics waste from its source to a place where it can be recovered.

A-19 Commingled Plastics - Mixture of materials or products consisting of different types of plastics.

NOTE — The term "mixed plastics" is used synonymously.

A-20 Commodity plastics — Plastics that are used in high volume usually known for their low costs making them popular in especially mass productions.

A-21 Compatibilizer — Substance used in polymer blends to enhance the blend properties while increasing adhesion between the phases, reducing the interfacial tension and stabilizing morphology.

A-22 Compostable plastic — Plastic that undergoes degradation by biological processes during composting to yield CO_2, water, inorganic compounds and biomass at a rate consistent with other known compostable materials and leave no visible, distinguishable or toxic residue.

A-23 Compounding — Process of melt blending or mixing of polymers and additives essentially with a goal to achieve a homogeneous blend.

A-24 Compression moulding — Method of moulding thermosetting or thermoplastic resins in which the material, generally preheated, is first placed in an open, heated mould cavity which is then closed with a top force or plug member and exposed to pressure to force the material into contact with all mould areas, while heat and pressure are maintained until the moulding material has solidified.

A-25 Contaminant — Unwanted substance or material.

NOTE — The term "impurity" is a deprecated synonym of contaminant and should not be used.

A-26 Converter — Specialized operator capable of shaping plastics raw material to make a usable semi-finished or finished product.

A-27 Copolymer — Polymer derived from more than one species of monomer.

A-28 De-gassing — Removal of contained or dissolved gases, vapours, water or monomer residues in the processing of a plastic material to avoid voids or other imperfections in the final product.

A-29 Degradability — Ability to degrade within a fixed period of time and under the influence of specified environments.

A-30 Degree of biodegradation — Mass fraction of an original polymeric item that is biodegraded under specified conditions as measured through specified techniques.

A-31 Depolymerization — Chemical reversion of a polymer to its monomer(s) or to a polymer of lower relative molecular mass.

A-32 Disposal — Any controlled operation, that is not recovery, e. g. by destroying or storing damaged, used or other unwanted plastic waste (Including incineration without energy recovery and controlled landfill).

A-33 Durability — Ability of a material to exist for a long period of time while retaining its original qualities and properties.

A-34 Elastomer — Macromolecular material which returns rapidly to its initial dimensions and shape after substantial deformation by a weak stress and release of the stress.

A-35 End-of-life — Point at which a product or component is taken out of use.

A-36 Energy recovery — Production of useful energy through direct and controlled combustion.

A-37 Environmental aspect — Element of an organization's activities, products or services that interacts or can interact with the environment

A-38 Environmental impact — Change to the environment, whether adverse or beneficial, wholly or partially resulting from an organization's environmental aspects.

A-39 Extrusion — Process whereby heated or unheated plastic forced through a shaping orifice becomes one continuously formed piece.

A-40 Feedstock Recycling — Same as chemical recycling.

A-41 Filler — Relatively inert solid material added to a plastic to modify its strength, permanence, working properties or other qualities, or to lower costs.

A-42 Flake — Plate-like regrind

NOTE — The shape of regrind depends both on the plastics being processed and the manner of processing.

A-43 Floatation / Float -Sink — Process for separating plastics from mixed plastics waste streams where the plastics are in a fluid that has density in between the materials making it possible for less dense material to float and heavier to sink.

A-44 Fluff — Filament-like regrind.

NOTE — Common usage of the term "fluff' also includes shredder residue fractions produced in the commercial recycling of durable goods such as automobiles.

A-45 Fragmentation — Breakdown of a polymeric item to tiny particles regardless of the mechanism.

A-46 Gasification — Transformation of organic materials into carbon monoxide, hydrogen and carbon dioxide by reacting the materials at high temperatures (> 700 °C), without combustion, with a controlled amount of oxygen and/or steam.

A-47 Granulation — The process of forming grains or granules from solid plastic, suitable for later compounding or recompounding in a plastics manufacturing or plastics conversion process.

A-48 Hazardous Waste — Waste that is suspected to have one or more hazardous properties and that must be handled in a specific way (according to precautionary actions) because it can be poisonous, explosive, corrosive, radioactive, harbour disease-causing microorganisms, or is hazardous for any other reason.

A-49 Homogenizing — Processing to improve the degree to which a constituent and/or property is uniformly distributed throughout a quantity of plastics material.

A-50 Homopolymer — Polymer derived from a single species of monomer.

A-51 High quality recycling — Recycling of relatively pure streams of waste plastics requiring only minimal sorting to remove any impurities that can deliver high-quality recycled materials with desired properties.

A-52 Incineration — Controlled burning of waste products or other combustible materials in an incinerator or similar apparatus.

A-53 Industrial Composting — Composting process performed under controlled conditions on industrial scale with the aim of producing compost for the market.

A-54 In-house recycling — Recycling of materials left over from product manufacturing in the same facility.

A-55 In House Scrap — Materials Scrap produced within the original manufacturing process and commonly reused by industry as normal practice.

NOTE — In-house scrap is not recycled material.

A-56 Injection moulding — Process of moulding a material by injection under pressure from a heated cylinder through a sprue into the cavity of a closed mould.

A-57 Landfill — Waste disposal site for the deposit of waste on to or into land under controlled or regulated conditions.

A-58 Life cycle — Consecutive and interlinked stages of a product system, from raw material acquisition or generation from natural resources to the final disposal.

A-59 Litter — Solid object disposed of or abandoned in the environment.

A-60 Lot — Definite quantity of some material manufactured or produced under conditions that are presumed uniform.

A-61 Master batch — Well-dispersed mixture of a polymer and high percentages of one or more components (colorants and/or other additives) in known proportions for use in blending in appropriate amounts with the basic polymer in the preparation of a compound.

A-62 Material recovery — Material-processing operations including mechanical recycling, feedstock (chemical) recycling and organic recycling, but excluding energy recovery.

A-63 Maximum level of biodegradation — Degree of biodegradation of a chemical compound or organic matter in a test, above which no further biodegradation takes place during the test

A-64 Mechanical Recycling — Processing of plastics waste into secondary raw material or products without significantly changing the chemical structure of the material.

A-65 Melt flow rate — Quantity of thermoplastic material extruded in a given time under specified test condition.

A-66 Micronization / Micronizing — Process by which a material / plastic is ground into a fine powder.

A-67 Microplastic — Any solid plastic particle insoluble in water with any dimension between 1 gm and 1000 um (= 1 mm).

A-68 Monomer — Chemical compound, usually of low molecular mass, that can be converted into a polymer by combining it with itself or with other chemical compounds.

A-69 Natural Polymer — Polymer obtained from biomass, in which the polymer retains the original chemical structure and composition present in biomass.

A-70 Organic Recycling — Same as biological recycling

A-71 Plastics — Material which contains as an essential ingredient a high polymer and which at some stage in its processing into finished products can be shaped by flow.

NOTE — Elastomeric materials, which also are shaped by flow, are not considered as plastics.

A-72 Plasticizer — Substance of low or negligible volatility incorporated in a plastic to lower its softening range and to increase its workability, flexibility or extensibility.

A-73 Plastics Leakage — Unintentional release of plastics into the environment.

A-74 Plastic Pollution — Plastic present in the environment that adversely affects the environment.

A-75 Plastic Waste — Any plastic material or plastic object which the holder discards, or intends to discard, or is required to discard.

A-76 Post-consumer Plastics — Descriptive term covering plastic waste, generated by the end-users of products, that has fulfilled its intended purpose or can no longer be used as originally intended (including plastics returned from within the distribution chain).

A-77 Pre-consumer plastics / Post-industrial plastics — Plastic material diverted during a manufacturing process. This term excludes re-utilized materials such as rework, regrind or scrap generated in a given process and is capable of being reclaimed within the same process.

A-78 Pretreated Waste — Waste that has been treated to make it more suitable for recovery or disposal.

A-79 Purge Material — Material resulting from the passing of polymer through plastics processing equipment for the purpose of cleaning the equipment, or when changing from one polymer to another, or when changing from one colour or grade of polymer to another.

A-80 Pyrolysis — Irreversible chemical decomposition caused solely by a rise in temperature.

A-81 Recovered Material — Plastics material that has been separated, diverted or removed from the solid-waste stream in order to be recycled or used to substitute virgin raw materials.

A-82 Recovery — Processing of plastics waste material for the original purpose or for other purposes, including energy recovery.

A-83 Recyclate — Plastics material resulting from the recycling of plastics waste.

NOTES:

1. The terms "plastics secondary raw material", "recycled plastics" and "regenerate" are sometimes used synonymously.

2. As soon as the used plastics material has been treated in such a way that it is ready to replace a virgin product, material or substance in a production process, it loses its characteristics as waste.

A-84 Recycled plastic — Plastic prepared by processing in a production process from plastics waste materials for the original purpose or for other purposes but excluding energy recovery.

A-85 Recycling — Processing of plastics waste materials for the original purpose or for other purposes, excluding energy recovery.

A-86 Regeneration — Plastic recovery process that enables to produce granules including compounding.

A-87 Regranulated plastic — Recycled plastic granules made from production waste.

NOTE — Should not be confused with recyclates that refer to post-consumer waste.

A-88 Regrind — Shredded and/or granulated recovered plastics material in the form of free-flowing material.

NOTE — The term "regrind" is frequently used to describe plastics material in the form of scrap generated in a plastics processing operation and re-used in-house. This term is also used to describe fine plastics powder used as filler in the recovery of plastics.

A-89 Regulated plastic product — Product or component, which is specifically regulated by any regulatory body, e.g., medical device, item in food contact, etc.

A- 90 Reuse — Use of a product more than once in its original form.

NOTE — In view of the fact that a re-used product has not been discarded, re-use does not constitute a recovery option.

A-91 Service Life — Period of time during which a product in use meets or exceeds the performance requirements.

A-92 Shredding — Any mechanical process by which plastics waste is fragmented into irregular pieces of any dimension or shape.

NOTE — Shredding usually signifies the tearing or cutting of materials that cannot be crushed by fragmentation methods applicable to brittle materials, as typically carried out in a hammer mill.

A-93 Sorted Plastic Waste — Plastic waste sorted by polymer type or polymer family ready to be used in recovery or recycling process.

A-94 Toxicity— Ability of a substance to produce an adverse effect upon a living organism.

A-95 Virgin plastic — Plastic material in the form of pellets, granules, powder, floc, etc., that has not been subjected to use or processing other than that required for its initial manufacture.

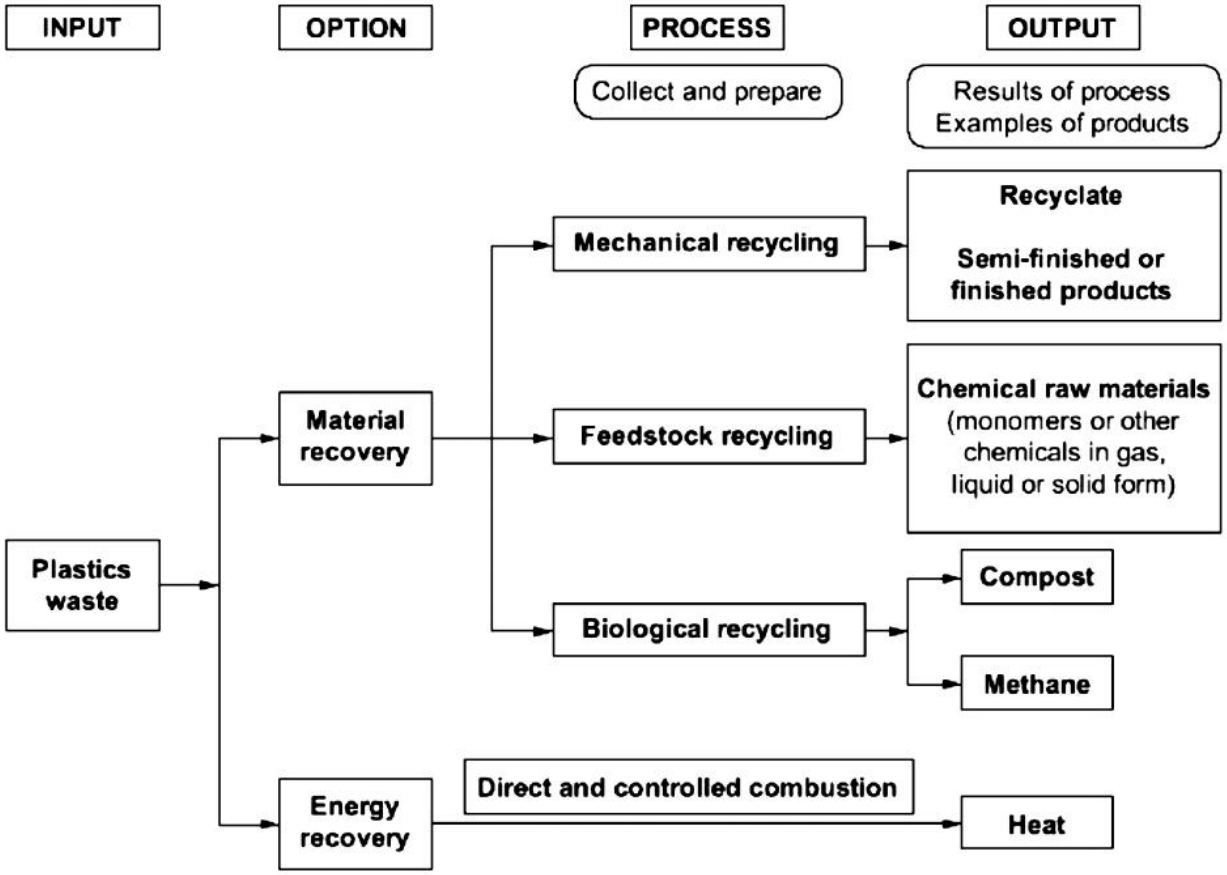
A-96 Waste — Any material or object which the holder discards, or intends to discard, or is required to discard

A-97 Waste-to-Energy process — Combustion of waste, with the primary goal of energy recovery

Annex B

(Informative)

Indicative schematic diagram of some plastics recovery options:



Annex C

(Informative)

Plastics Recovery and Integrated Resources Management