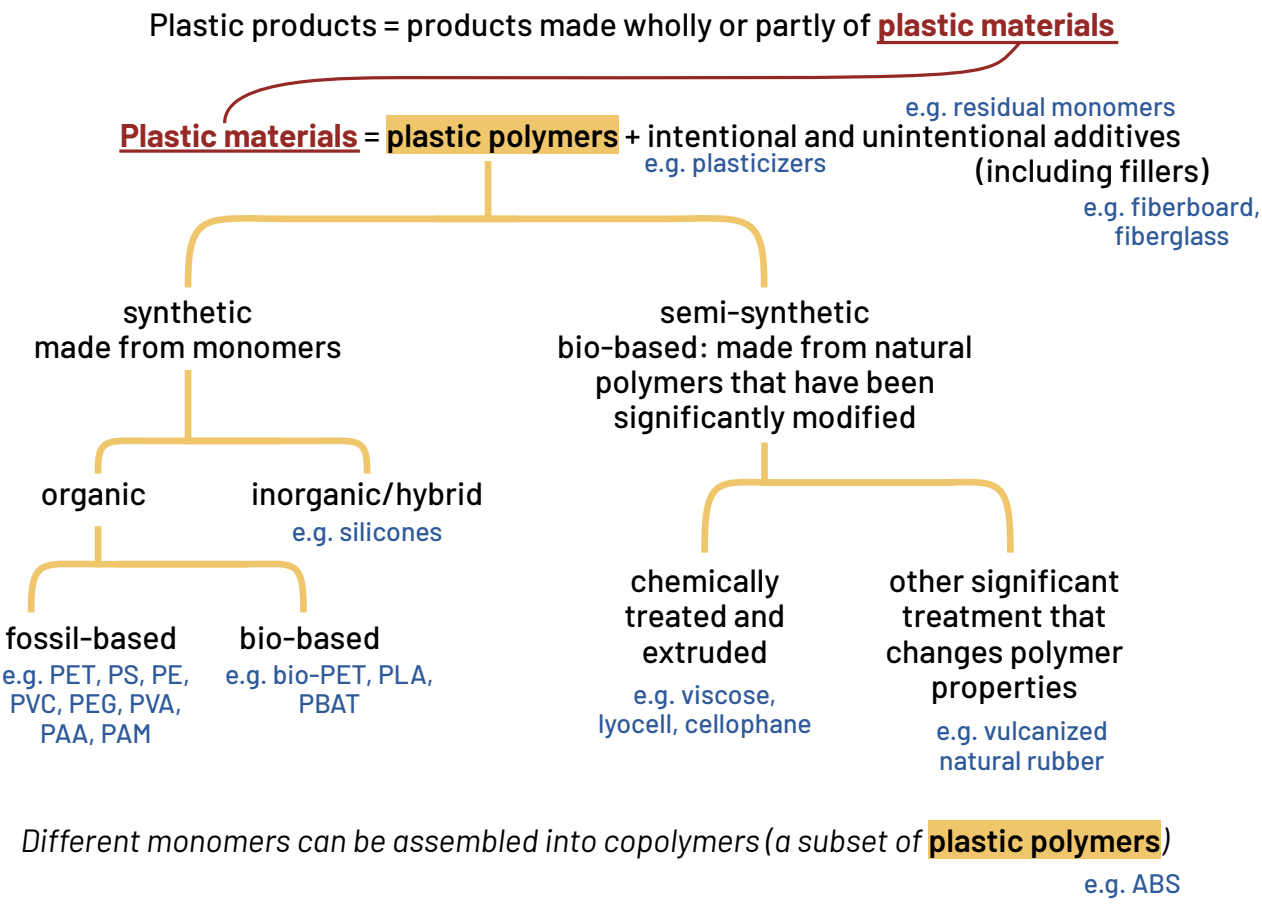
Defining plastic products, materials and polymers: a proposal

To fulfill the UNEA mandate of covering pollution across the lifecycle of plastics, a global treaty must regulate plastics first and foremost as a material. Adequate definitions of plastic products and polymers will also be needed to capture the full range of sources of plastic pollution.

1. Plastic products = products made wholly or partly from plastic materials

Plastic products are **products made wholly or partly from plastic materials**, including multilayer products that are made with plastic layers or laminates. They also include intermediate products such as pellets, expanded polystyrene beads, rolls of film and primary microplastics used to manufacture other products.

Figure 1: Defining plastic products, materials and polymers



2. Plastic materials (plastics) = plastic polymers + intentional and unintentional additives (including fillers)

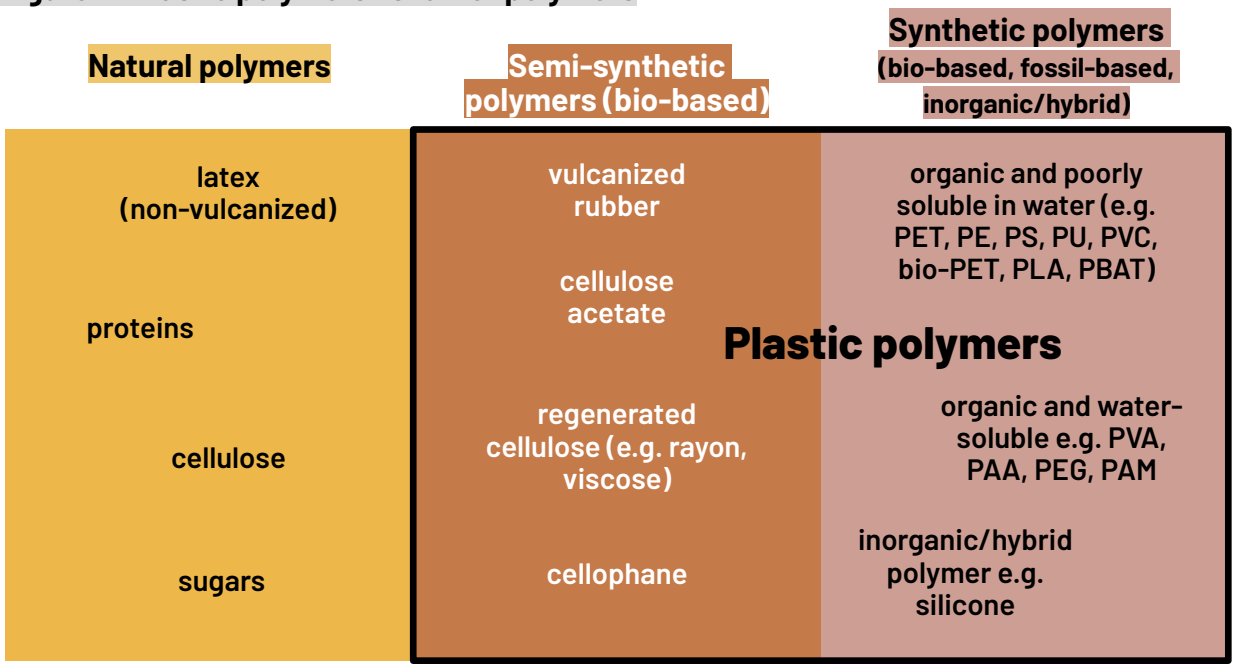
Plastics are materials consisting of **plastic polymers and additives, both unintentional and intentional, including fillers.** Intentional additives are added by design (e.g. plasticizers, flame-retardants, fillers) while unintentional additives include contaminants from production or other lifecycle stages (e.g. residual monomers or catalysts, environmental pollutants.

Plastics with fillers (e.g. fiberboard or fiberglass) are sometimes described as composites. Composites with plastic content contribute to pollution across the lifespan of plastics and have been proposed for inclusion in the definition of microplastics (Hartmann et al., 2019). **As such, composites should be covered under a plastics treaty.**

3. Plastic polymers = synthetic and semi-synthetic polymers

A polymer is a substance composed of very large molecules with many repeating subunits (monomers). Most plastics are made from synthetic polymers. Synthetic polymers can be organic, inorganic or hybrid (organic-inorganic) polymers. Some plastics are also made from semi-synthetic polymers—natural polymers that have been modified to an extent that changes their properties. For instance, the crosslinking that occurs when natural rubber is vulcanized changes the polymer's rigidity and its water absorbency. **Both synthetic and semi-synthetic plastic polymers have been implicated in plastic pollution** (Hartmann et al., 2019) **and should be covered under a plastics treaty.**

Figure 2: Plastic polymers vs. other polymers



4. Plastic polymers have a range of states of matter, solubility and absorbency

The diverse range of states of matter and solubility among plastic polymers makes those specific criteria impractical to define plastic polymers.

Most but not all plastic polymers are solid at room temperature. Plastic polymers are usually either thermoplastic (that can be remelted) or thermosetting (undergo an irreversible hardening process). Elastic plastic polymers (elastomers) are either thermoplastic or thermosets (IPEN, 2022). But they can be liquid or gel-like at room temperature.

For instance, thermoset plastics are liquid before the curing (hardening) process. Some thermoplastics are not full polymers in their uncured form (e.g. epoxy) while others are already full polymers when uncured, but undergo crosslinking during curing which makes them rubber-like (e.g. polydimethylsiloxanes or PDMS, a form of silicone). Some thermosets are designed to remain uncured (in their non-solid form).

Uncured, non-solid thermosets are persistent pollutants. Liquid PDMS (silicones) are particularly persistent in water and a problem for wastewater treatment because they do not biodegrade (Teixeira et al., 2005). They also have known toxic impacts: uncured epoxy triggers endocrine disruption and developmental toxicity in rats (Hyoung et al., 2007), while liquid silicones cause oxidative damage in crayfish (Hossain et al., 2021). In sum, **non-solid plastic polymers trigger toxic hazards and pollute the environment, and should therefore be covered under a plastics treaty.**

Plastic polymers also have differing degrees of water solubility and absorbency at room temperature. Most plastic polymers do not dissolve well in water at room temperature, nor do they absorb water—however, some are water-soluble or absorb water to form hydrogels.

Water-soluble synthetic polymers such as polyvinyl alcohol (PVA) have been implicated in microplastic pollution as their dissolution in wastewater and in the environment is incomplete (Rolsky & Kelkar, 2021). Hydrogel microbeads of synthetic polymers including polyacrylates, polyacrylamides, and copolymers of acrylates and acrylamides, are used to coat seeds and agrochemicals and have also been implicated in microplastic pollution, as they are non-biodegradable (Chen et al., 2022). **For those reasons, water-soluble and water-absorbent synthetic polymers must be covered under a plastics treaty.**

5. Proposed defining criteria

Plastic products are products made wholly or partly from plastic materials.

Plastics are materials consisting of plastic polymers and additives, both unintentional and intentional, including fillers.

Plastic polymers include all synthetic polymers (organic, inorganic and hybrid) as well as all semi-synthetic polymers, in their diverse states of matter, water solubility and water absorbency.

Semi-synthetic polymers are natural polymers that have been modified or engineered in a manner that changes their properties.

For more information relevant to the global plastics treaty:
https://no-burn.org/unea-plastics-treaty

GAIA's recommendations for INC1
https://www.no-burn.org/wp-content/uploads/2022/11/recommendations-for-INC1.pdf

GAIA is a network of grassroots groups as well as national and regional alliances representing more than 1000 organizations from 92 countries. We envision a just, zero waste world built on respect for ecological limits and community rights, where people are free from the burden of toxic pollution, and resources are sustainably conserved, not burned or dumped. We work to catalyze a global shift towards environmental justice by strengthening grassroots social movements that advance solutions to waste and pollution.

Learn more at **www.no-burn.org**

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