# Technological products

Technological products are material (tangible) objects that have been designed by people and developed through technological practice to serve particular functions.

In every technological product there is a crucial relationship between the (chemical) composition and structure of the materials used and their performance properties. For this reason, technologists need to be able to evaluate different materials and select the most suitable for their purpose. They also need to understand how existing materials can be modified or new materials formulated, and how choice of materials impacts on the design, development, maintenance, and disposal of technological products.

## Key ideas

### Products and systems

Technological outcomes can be classified as products or systems, or both (see Characteristics of technological outcomes). But in this component the focus is on technological outcomes as products and, more specifically, their material natures.

### Performance properties

This component is primarily about the identification, description, use and development of materials, and the impact that selection of materials has on the fitness for purpose of technological outcomes.

Different products require different knowledge bases, depending on the kinds of materials to be used. For example, the knowledge bases required for understanding and/or developing food products, garments, or furniture will all be very different.

All materials have properties that can be measured objectively and/or subjectively – these collectively determine the overall performance properties (characteristics such as thermal conductivity, water resistance, texture, flexibility or colour) of a material.

People perceive properties such as taste, feel, texture, or ease of use differently, so they can only be measured subjectively, but properties such as conductivity, UV resistance, tear resistance or tensile strength can be measured objectively using appropriate equipment calibrated to an established standard.

To be fit for purpose, a product must be made of materials that will (i) enable its successful functioning and (ii) make it acceptable to users (safe to use, environmentally friendly, economically viable, ethically OK, etc., depending on the product).

Material properties are determined by the type and arrangement of the particles that make up the material, that is, by their chemical composition and structure.

Materials can be formed, manipulated, and/or transformed to enhance the fitness for purpose of a technological product.

### Forming materials

Forming involves bringing two or more materials together to create a new material that has a different chemical composition and structure, and (therefore) different performance properties. For example, mixing flour, water, and salt to make dough; mixing wood fibres, resin, and wax to make medium-density fibreboard (MDF); combining glass fibre and a polymer resin to form fibreglass or fibre-reinforced polymer (FRP).

### Manipulating materials

Manipulating involves working existing materials in ways that do not change their composition and structure, or (therefore) their properties. Rather, manipulation allows the material to be incorporated into a product in ways that maximise its contribution to the overall performance of the product.

Manipulation can involve, for example, laminating materials, changing the shape of materials, or joining different materials together. Cutting, moulding, bending, jointing, gluing, and painting are examples of manipulative operations.

### Transforming materials

Transforming involves changing the physical structure or particle alignment of a material (and therefore, some of its properties), without changing its chemical composition. For example, felting; beating an egg white; heat treating a metal to harden or anneal it; steaming timber to soften its fibres so that it can be manipulated (bent).

When developing technological products, the techniques/operations can involve a combination of forming, manipulation, and/or transformation.

### Evaluating and selecting materials

For any technological product materials are selected because their performance properties will help ensure that the product meets the required performance criteria. Some material properties (for example, wood grain or colour) may be valued for what are fundamentally aesthetic reasons. Materials need to be properly evaluated so that those selected can be justified as optimal (not merely satisfactory), taking account of all the relevant factors.

When evaluating the suitability of materials it is important to understand their composition as well as the techniques and/or procedures used to form, manipulate and transform them.

Technologists often use specialised language and symbols to communicate specific information about materials.

### Materials development

Today, materials development cuts across boundaries between traditional disciplines, leading to the creation of innovative materials (for example, “smart” materials) with exciting performance properties and to the development of technological products that perform new functions.

Developers looking to create new materials must first know the strengths and weaknesses of existing materials, understand how chemical composition and structure can be changed, and be able to anticipate future needs and desires. They also need to be aware that new evaluative procedures may need to be devised to assess the suitability of new materials.

### “Smart” materials

The development of “smart” materials with totally new performance properties opens up opportunities for the development of new kinds of products.

What makes a material “smart” is its ability to change or adapt in response to an external stimulus (trigger) or input, which may be technological, environmental or human. The stimulus causes a transformation in the properties of the material itself.

Products developed using smart materials include heat-regulating clothing, light-responsive sunglasses, artificial muscles, self-cleaning textiles, self-adjusting optical lenses, colour-changing shirts, and self-healing paint. See the case study Smart Fibres for an example of a development that uses a smart material.

### Impact of materials selection

Materials selection, evaluation and development has a major impact on product design, development, maintenance, and disposal. By exploring this impact students grow their understanding of sustainability, relating as it does to justifiable resource management, the designed-for-life cycle, and disposal, all of which are key factors to be considered when making product design decisions.