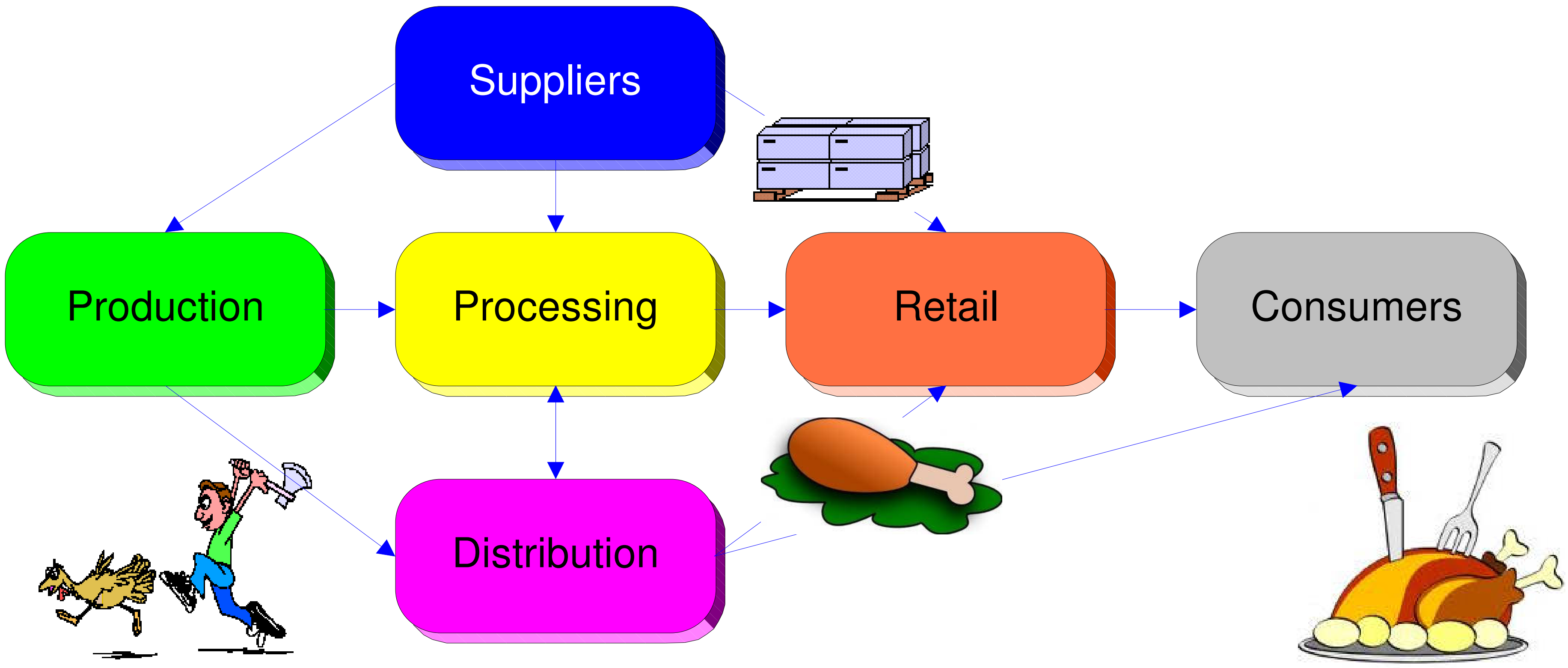
NSF

Packaging Hygiene for bottled water and beverage production

Dagmar Engel

The food chain …

… affects every person every day of their life !



Individual control systems

- Quality Management
- GMP / GHP
- Due Diligence
- HACCP






Hygiene Certification

A Tool of Competition

A Tool of Trust

Current standards for packaging manufacturers

- BRC/IoP Global Standard
- GMP FEFCO Standard
- INREKA Standard
- ISO FSSC 22002-4
- DIN EN 15593:200
- IFS PACsecure Standard
- AIB Consolidated Standard:
  Food Contact Packaging Manufacturing Facilities

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approved by GFSI

What can you expect from your supplier ?

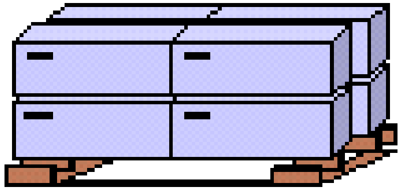
- Risk management
- Documentation control
- Agreements on specifications
- Management of product recalls
- Product traceability
- Management of customer complaints
- Supplier evaluation

… and **hygiene** management …

But where does it start …. and where does it end ?

Food packaging



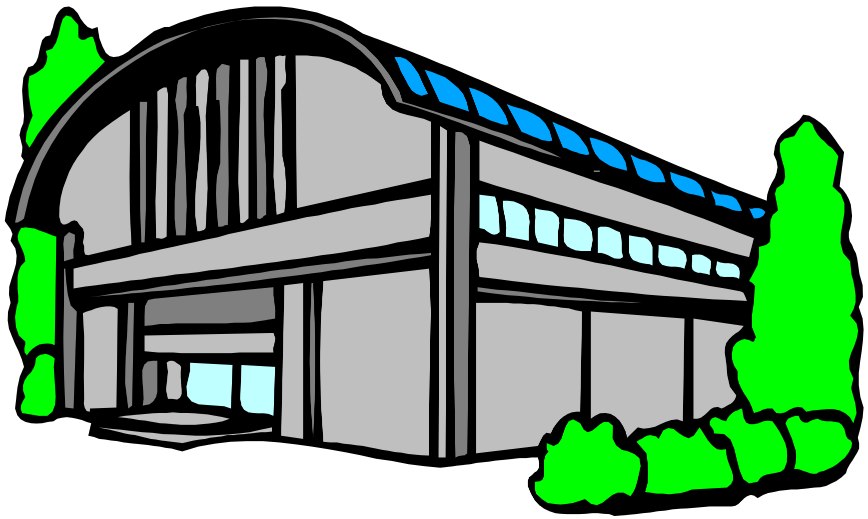
- primary or sales packaging – that which surrounds the product when it is sold to the final consumer
- secondary or grouped packaging – used to collate sales units
- tertiary or transport packaging – used to facilitate handling and transport to prevent physical handling and transport damage






Key Areas of Hygiene Controls

- Premises and equipment
- Personnel
- Practices
- Products



Risk assessment for food packaging

Product risks

- most raw materials are inert
- sterilized by process temperature
- no moisture or nutrition for microorganisms
- migration of carcinogens
- need to resist external factors
- risk of process contamination

Packaging functions

- contain the product
- protect the product
- preserve the nature of the product
- provide a convenient way of handling the product
- sell the product

Food protection

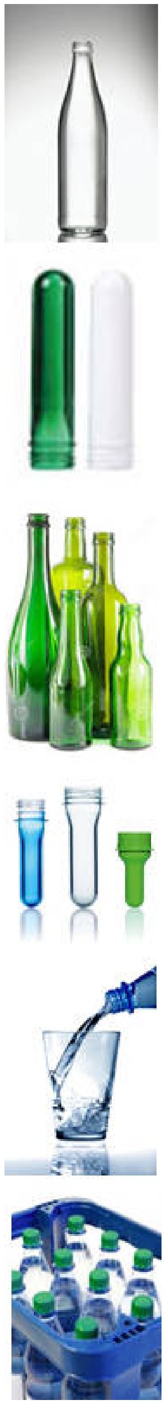
- prevention of physical damage
  - mechanical shock
  - deformation
  - climatic factors





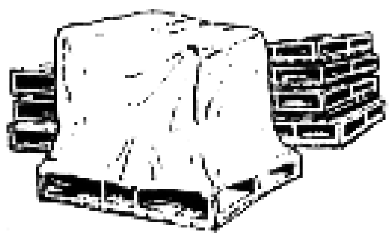

Food preservation

- prevent spoilage
- preserve aroma
- prevent off-flavours
- extend shelf-life of product



Product handling

- provide effective transport and distribution of the product
- provide effective storage options
- special requirements
  - child restraint closure
  - tamper evidence
  - facilitated handling for handicapped persons








Selling the product

- communication
  - What is this?
  - Who is selling this?
- giving the message
  - by the selected material
  - by shape and size
  - by colour
  - by text and illustrations

Typical Risk Factors





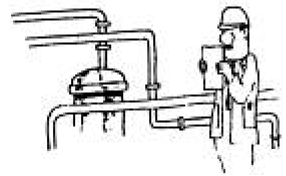

- raw materials – problematic intrinsic factors
- containers – product-specific risks
- equipment – bad operation or insufficient maintenance
- people – bad hygiene practice

Where hazards may occur ...

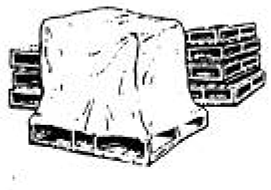
Raw Material

Receiving & Handling

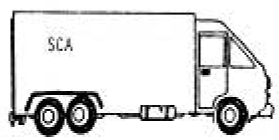
Processing



Packaging



Storage & Distribution



Handling & Consumer use

Typical Hazards

- biological hazards (bacteria, moulds) i.e.
  - Salmonella
  - E. coli
  - Staphylococcus aureus
  - Moulds/mycotoxins
- chemical hazards (chemical residues) i. e.
  - cleaning chemicals
  - lubricants
- physical hazards (foreign bodies) i. e.
  - splinters
  - glass
  - insects



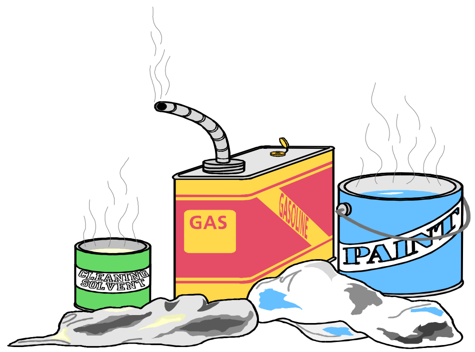



Some typical vectors of cross contamination

- hands
- cloths
- auxiliary items
- dirty working surfaces
- dust
- insects
- rodents
- dirty pallet layers or transport boxes

Control of chemical hazards

- at point of receipt
  - specification
  - supplier's guarantee
  - technical data sheets
  - use of non-toxic, food-compatible compounds wherever product contact is possible
- at point of use
  - intended use
  - correct labelling of containers
  - safe operating practices
  - written instructions



Physical Contamination
in Packaging Materials

- Loose fasteners, nuts & bolts
- Frayed conveyer belts & their mouldings
- Temporary engineering
- Oil and grease leaks
- Operator’s hair
- Glass
- Staples/pins
- Earplugs, pens
- Pallet, chock or other wood splinters
- Taint from dirty, wet or infested pallets
- Knife blades or needles
- Material waste offcuts
- Personal jewellery
- Vermin
- Flaking paintwork
- Tampering

A HACCP-type approach for food packaging manufacturers

- must rely on a solid hazard analysis
- needs to take into account individual products and manufacturing processes
- depends on hygiene prerequisites
- usually focusses on environmental controls






Modern bottle manufacturing


- glass containers
- plastic bottles






What is glass anyway ?

The term “glass” refers to an inorganic substance, usually composed of silica sand, sodium carbonates and other mineral components, i.e. lead, aluminium or cobalt compounds.

Typical risks: glass containers

- contaminated surface coatings
- glass splinters, „bird swings“
- microbial contamination (manual sorting process)

Glass container factories

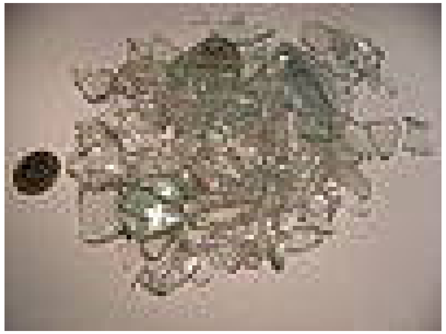
Modern glass container factories are three-part operations:

- the **batch house**
- the **hot end**
- the **cold end**

The batch house handles the raw materials; the hot end handles the manufacture proper — the furnaces, annealing ovens, and forming machines; and the cold end handles the product-inspection and -packaging equipment.

The raw materials

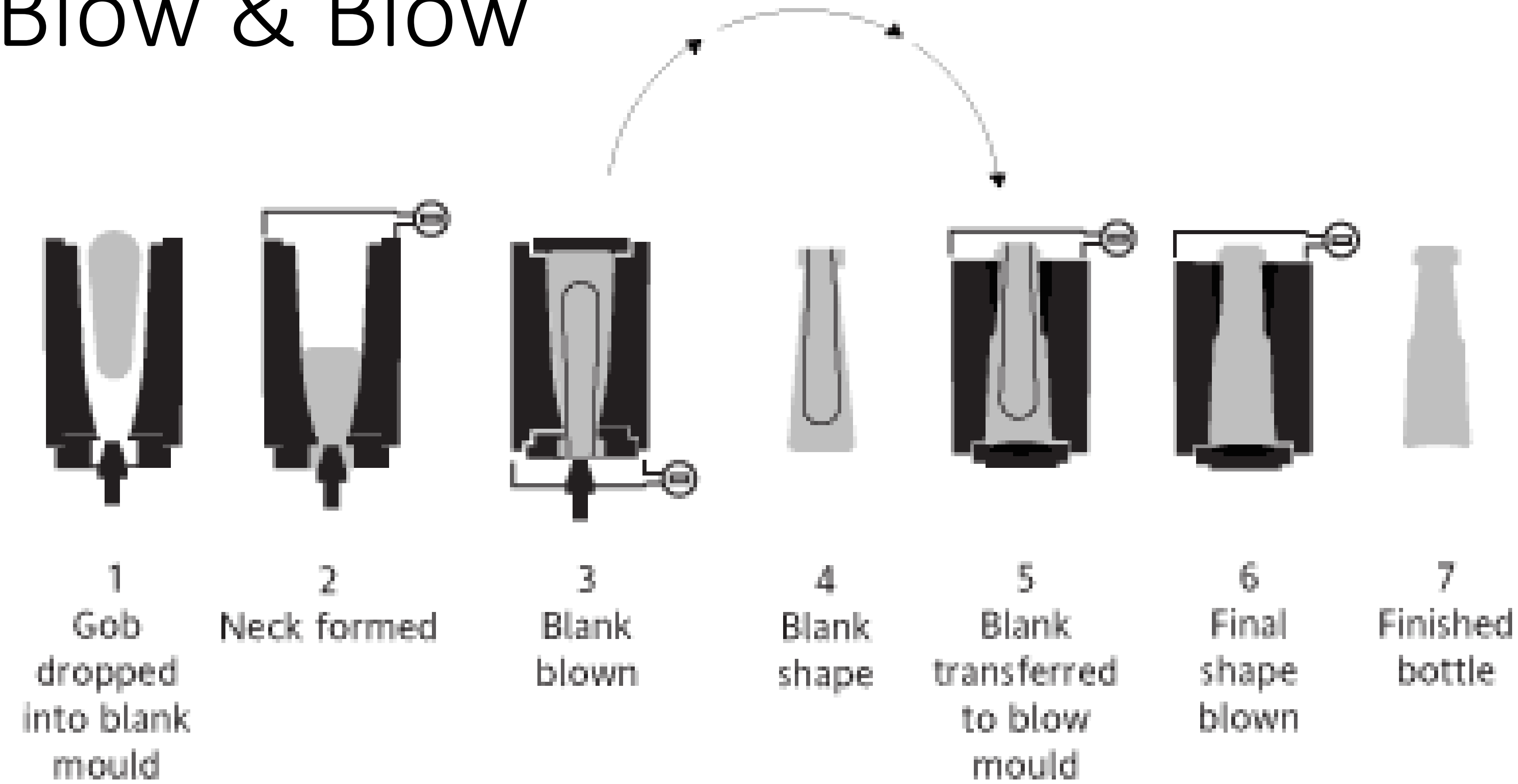
- Silica sand (quartz)
- Sodium carbonate
- Potassium carbonate („potash“)
- Feldspar
- Limestone
- Dolomite
- Cullet

Glass that is crushed and ready to be remelted is called **cullet**. In addition to the mineral ingredients, a glass batch traditionally consists of 25 to 90 percent cullet. Cullet is crushed rejected glass, generally of the same composition as the mineral mixture, that is included because its early melting in the furnace brings the mineral particles together, resulting in accelerated reactions. In average 64% of glass produced in Europe is made of recycled glass.

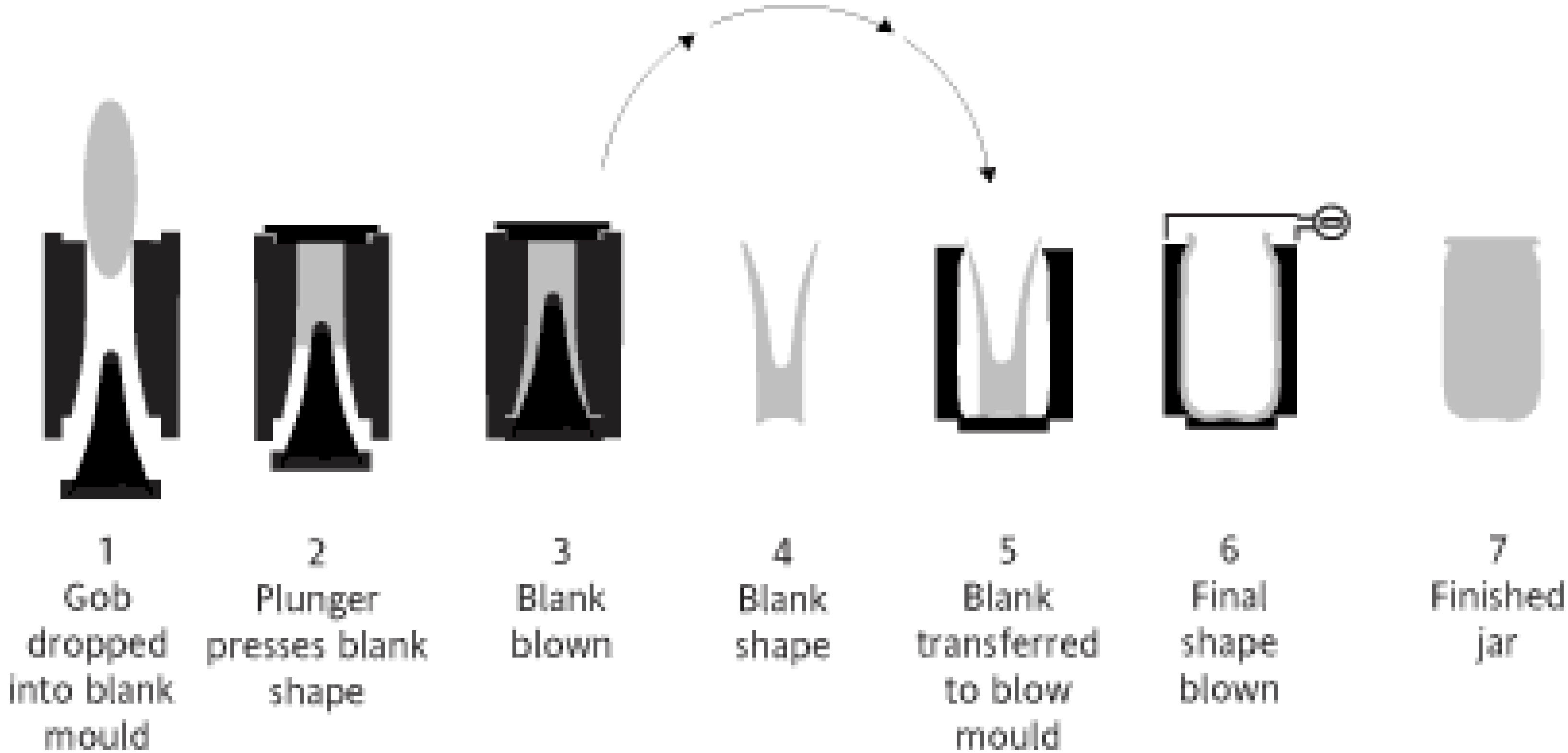

GLASS PRODUCTION

Blow & Blow


1
Gob dropped into blank mould
2
Neck formed
3
Blank blown
4
Blank shape
5
Blank transferred to blow mould
6
Final shape blown
7
Finished bottle


GLASS PRODUCTION

Press & Blow


1
Gob dropped into blank mould
2
Plunger presses blank shape
3
Blank blown
4
Blank shape
5
Blank transferred to blow mould
6
Final shape blown
7
Finished jar






The next stages ...

- Hot end conveyor
- Lehr (tempering)
- Cold end coating
- Inspection machines
- Palettizing / shrink wrapping
- Storage
- Re-sorting



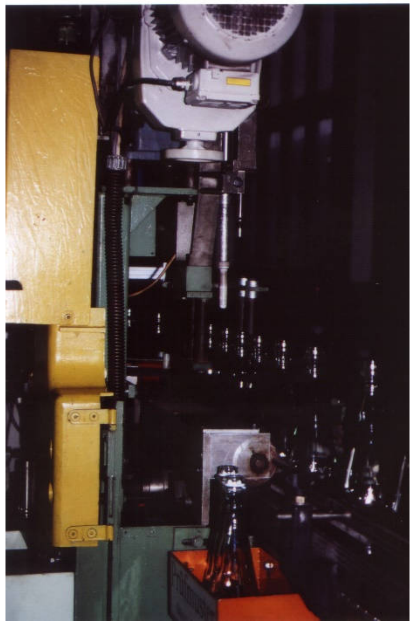



Modern glass manufacturing features:

- Automated batch dosage system
- Electronically furnace supervision
- Closed conveyors between IS-machine and Lehr
- Controlled glass cooling
- Parameter inspection at the cold end

Typical bottle inspections

- „bottle spacer“
- „squeeze test“
- diameter check
- „crack detector“
- thickness
- visual test
- special checks for carbonated liquids








You would not expect any chemical risks from the "glass" itself. There is, however, a risk of chemical interactions between the different surface coatings which are applied to the formed glass vessel at the "hot end" (before entering the lehr) and after the annealing process ("cold end").

These surface coatings are usually watery dispersions of waxes and synthetic compounds. They are meant to coat the surface of the glass container to reduce the coefficient of friction of the finished product, but depending on the spraying mechanism it is possible that these substances can also reach the interior of the container. It is a legal requirement that cold end surface coating formulations have to be food-grade, but excessive concentrations inside the glass container have to be regarded as an unwanted contamination.

So where‘s the hygiene?

What do I need to check doing a supplier audit ?

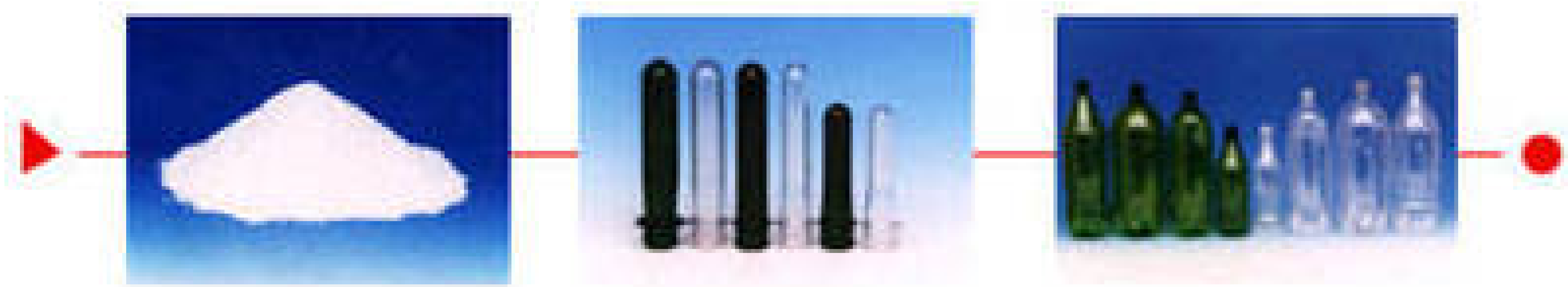
Important check points

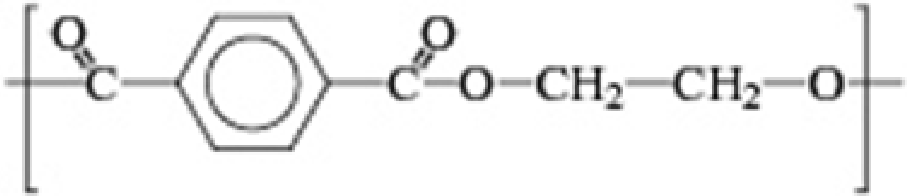





- Does your supplier operate a zone concept?
- How do they control the moulds?
- Which parameters (AQLs) are checked? How?
- Which surface coating formulations are used ?
- What are the concentrations? Is it possible that the concentration is over-dosed?
- Is it possible that the cold-end coating can contaminate the inside of the glass container?
- Which personal hygiene rules are stablished
  - At the cold end
  - In the sorting area

The manufacturing of PET bottles





Polyethylenterephthalate (PET)

01

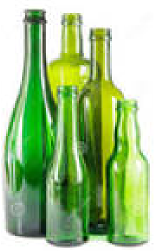
PET

Sorry, not THIS kind of PET….

Polyethylene terephthalate, commonly abbreviated **PET**, is a polymer resin of the polyester family and is used in synthetic fibers; beverage, food and other liquid containers.

Because PET is an excellent water and moisture barrier material, plastic bottles made from PET are widely used for carbonated water and soft drinks.






PET

- Thermoplastic synthetic substance
- High break resistance and shape retention
- At 140 °C transition from amorphous into crystalline stage
- High translucency
- Melting point 235-260 °C.






The main advantages of PET

- Pure – PET does react with the food or beverage which is kept within the container. Therefore, PET complies with international food contact regulations.
- Lightweight – 10 times, lighter than a glass pack, PET bottles, hence, reduces shipping costs by 30%.
- Crystal Clear – The product looks clean and healthy and in physical good shape. These attract attention and increases the sales of the products contained within it.





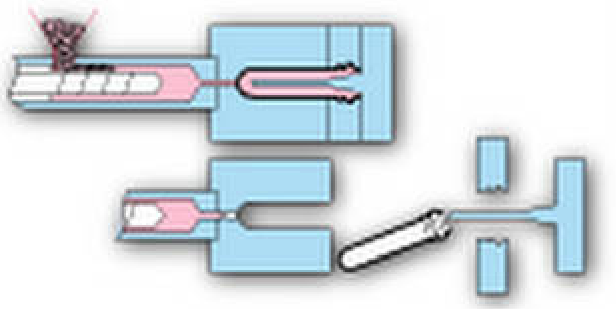

…and more:

- No Leakage – due to the absence of a weld line in the bottom the PET bottles leakage does not occur.
- Design Flexibility – can be designed in all shapes and sizes, designs and colors.
- Recyclable – as it is one single material, PET bottles can be washed and crushed into flakes and remolded into shape.

PET resin is used to produce PET preforms which are then used to blow PET bottles using high pressure and bi-oriented process.






The process is simple, the heated PET which is in the molten form is injected into the injection chamber,by the rotation of screw barrel within the machine, until the chamber is full.

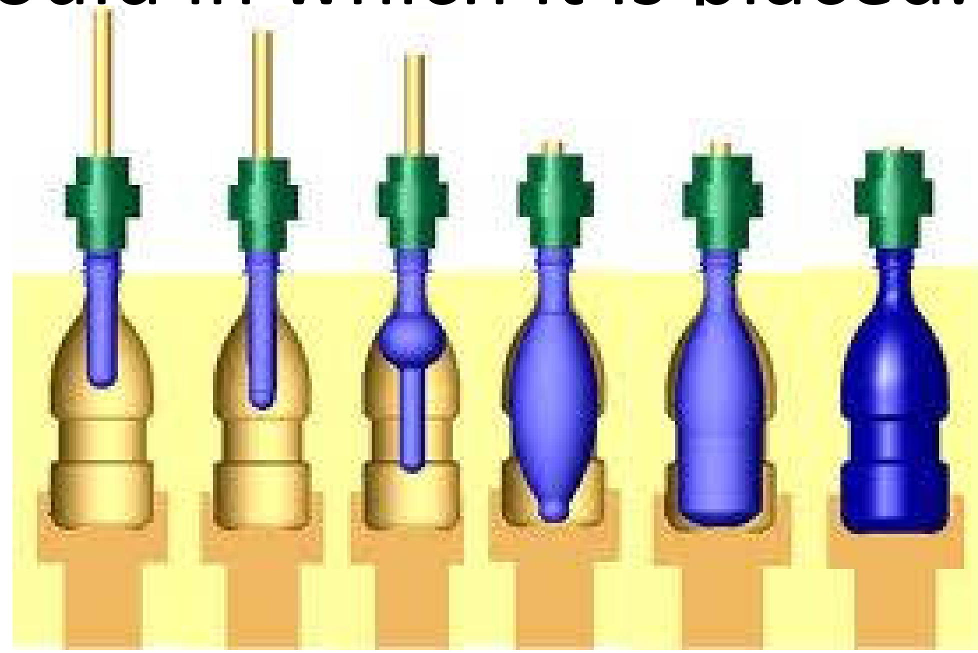
Once the chamber is full, the screw pushed forward to fill the injection cavity with molten plastic through the nozzle into the mold.

The temperature within the injection molding machine are different, at the rear end of the machine the temperature should be around 275°C, at the middle of the machine about 282°C, at the nozzle about 280°C. And at the runner the temperature should be around 270°C for the bottle formed to have optimum specifications. (These temperature may vary a little depending on the design of the mold)

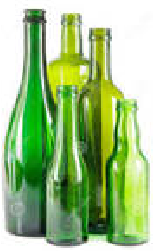





The preform is then reheated to around 110°C and blow-moulded into its finished form in a separate machine by injecting high-pressure air that forces the material into the exact shape of the water-cooled mould in which it is placed.

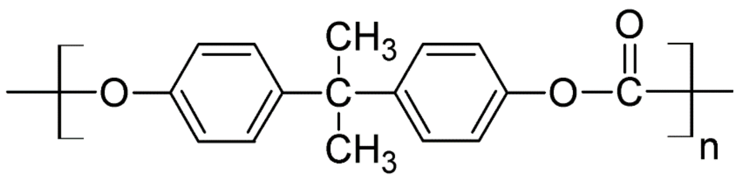







Polycarbonate containers

Polycarbonates (**PC**), known by the trademarked names Lexan, Makrolon, Makroclear and others, are a particular group of thermoplastic polymers. They are easily worked, moulded, and thermoformed. Because of these properties, polycarbonates find many applications. Note that articles made from polycarbonate can contain the precursor monomer bisphenol A (BPA).





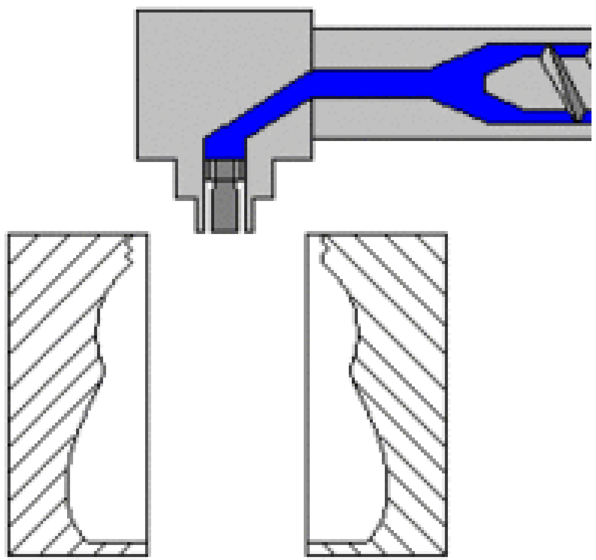



A polycarbonate bottle is a shatter-resistant container that weighs less, but is more durable, than a glass bottle. Bottles/containers made of polycarbonate are frequently used as potable water containers that are lightweight and unbreakable, as well as reusable.

The polymer material used to manufacture these giant water bottles is designed to be lightweight and break-resistant. Though quite large, the polycarbonate bottle itself adds little to the overall weight of the water, making it easier to heft the jugs when full.


Transparency, excellent toughness, thermal stability and a very good dimensional stability make Polycarbonate (PC) one of the most widely used engineering thermoplastics.

Polycarbonate bottles are manufactured by a process called blow injection moulding.



Same as PET bottles, polycarbonate items starts as a resin. It needs to be injected into the mould via a nozzle or tube, depending upon the application, and cooled to make the mold solid.
The injection moulding process happens between 280 – 320 °C.






So far – what can happen ?

The microbiological risk is fairly low….

Typical Risks:
Plastic Packaging Materials

- global or specific migration
- germs/dust particles attracted by electrostatic charge of surfaces
- insufficient barrier properties

In terms of risk assessment we need to look at ingredients which have the potential to migrate into the content. These substances are usually auxiliary additives such as catalysts, lubricants, antistatics, antioxidants, stabilizators etc.

Additionally, polycarbonate bottles can be attacked by many organic solvents.

There has been some concern about toxic chemicals leaching into food when polycarbonate bottles are heated, as when warming a baby’s formula. A heated polycarbonate bottle will release BPA molecules to a very slight degree. Additionally, some people have expressed concern about scuffed or scratched bottles leaching BPA into food or beverages.






Is PET safe?

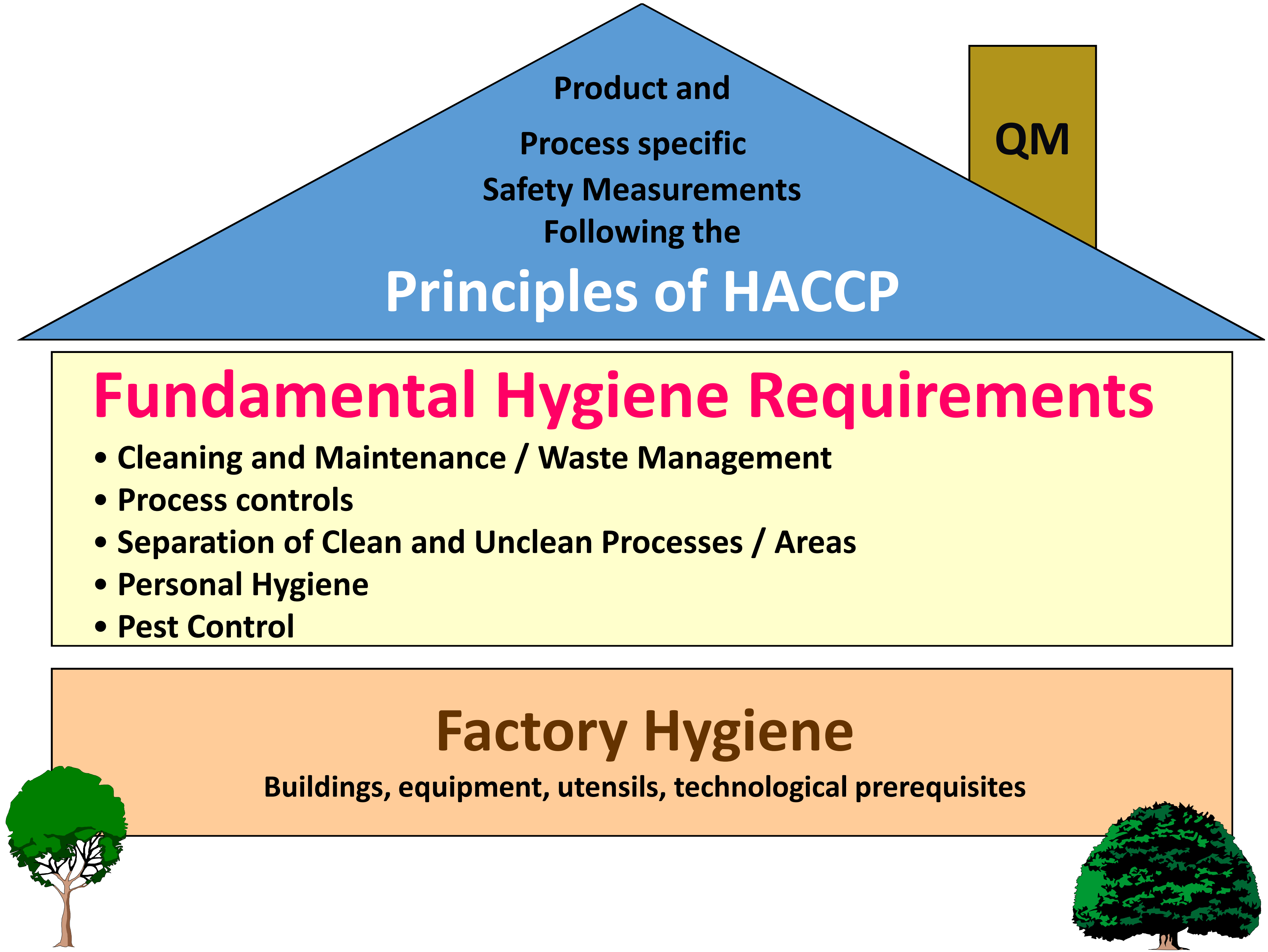
Numerous tests have found PET to be a safe material for the storage of food products.

Arguments

- Food-grade PET contains only very high molecular weight species with little or no migration propensity, so actual migration is minuscule.
- PET doesn‘t contain BPA (bisphenol-A) which is one of the major „scares“ in plastic food packaging.
- Antimony trioxide is a catalyst that is sometimes used in PET production. Numerous tests, however, have found that the level of antimony in bottled beverages falls well below even the strictest regulatory guidelines designed to protect public health.

What`s left : GMP –
Good Manners during Production

- clean and tidy workplaces
- foreign body control
- no temporary modifications
- special care when handling the product
- hygienic performance of maintenance work
- high standards of personal and professional hygiene


Product and
Process specific
Safety Measurements
Following the
Principles of HACCP
QM
Fundamental Hygiene Requirements
• Cleaning and Maintenance / Waste Management
• Process controls
• Separation of Clean and Unclean Processes / Areas
• Personal Hygiene
• Pest Control
Factory Hygiene
Buildings, equipment, utensils, technological prerequisites






So – what remains for you to do ?

- ✓ Check supplier declarations and certificates of analysis
- ✓ Make use of supplier evaluation questionnaires
- ✓ Audit your supplier