FOOD SAFETY ISSUES IN FOOD PACKAGING - ASEPTIC TECHNOLOGY APPROACH*

Hari Yanto Tekno Yuwono

Tetra Pak Indonesia

ABSTRACT

Companies involved in processing, marketing and distributing food products are fully aware of the growing pressure on assuring food safety and quality. UHT-treated and aseptically packaged products have become popular from the viewpoint of food safety and health. Aseptic processing and packaging allows sensitive liquid foods to stay safe and fresh and gently protects the natural flavour and nutritional content of liquid products. giving consumers more quality and better taste. Since the cartons can be stored un-chilled for months, consumers will benefit from improved food safety due to less spoilage and waste

The quality of raw (packaging) material, the UHT sterilization equipment, the aseptic packaging system, their process controls and quality system play important roles to determine food safety, quality and conformance of the finished products.

As the world's leading food processing and packaging solutions company, Tetra Pak is committed to making food safe and available, everywhere. And our commitment extends far beyond protecting the contents in a package. It also includes support for our customers' businesses, a responsibility to reduce our environmental impact, and shape a better future for all our stakeholders - from our employees, to our suppliers and the communities in which we operate.

ASEPTIC TECHNOLOGY AND ULTRA HIGH TEMPERATURE (UHT) PROCESSING SYSTEM

There are four fundamental blocks of aseptic technology. First is commercially sterile food that should be transferred aseptically into

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This manuscript is prepared by the seminar committee based on the recorded presentation of Mr. Yuwono.

the sterile surrounding and meet with **sterilized** packaging material so that we can have a result of aseptic **finished** product. **As** we **know,** there several causes of food spoilage, which **are** microorganisms, oxygen or other gases, light, moisture, and **odors.** For example, in a **milk product, as we can** see in Figure 1., in the same **period** of time, the growth of bacteria is significantly different depending on the temperature. That is the reason of immediate pasteurization or cooling process of fresh milk to maintain the growth of bacteria.

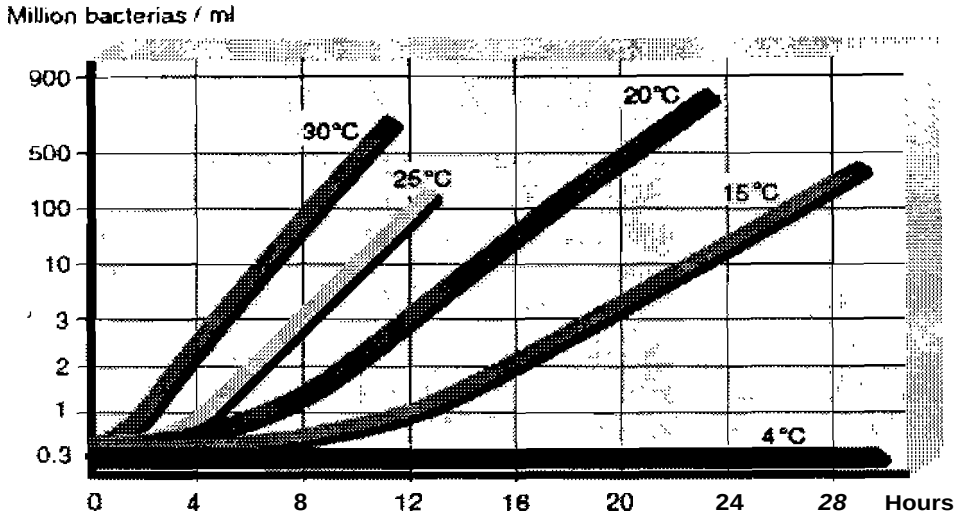

Figure 1. The amount of bacteria increases with milk temperature

One of the most effective ways to reduce the load of bacteria is heat treatment, e.g. pasteurization. However, we need a sterile product, not just a pasteurized one, in aseptic technology. In a sterile condition, a product should be free from all microorganisms. But, absolute sterility is not possible because of the logarithmic heat treatment reduction of **bacteria.** Therefore, **the** process **is** called commercial sterility. The commercially sterile product must **be** free from microorganisms and toxins harmful to the health of consumers, free from any microorganisms **that** can liable to proliferate during storage and able to be kept without deterioration, also stable and **having** good commercial value **during storage.**

To have a good product, we have to start from raw material because raw material **quality** is the **first** condition that determines the final product quality. It is **impossible** to produce a high quality product from poor quality raw materials, but it is quite possible to produce a poor quality product from high quality raw materials. Besides that, intermediate product quality is also important. So that pre-processing should also be in control, e.g. mixing, blending, de-aeration, separation, sampling analysis, standardization, homogenization, and pasteurization.

In FDA regulation 853/2004, it is stated that UHT is achieved by involving a continuous flow of heat at a high temperature for a short period **of** time (not less than 135°C in combination with a suitable holding time) so that there **are** no viable microorganisms or spores capable of growing in the treated product **when** kept in an aseptic closed container at ambient temperature. Also, the products should remain microbiologically stable after incubating for 15 days at 30°c or 7 **days at** 55°C in closed containers or after any other method demonstrating that the appropriate heat treatment has been applied.

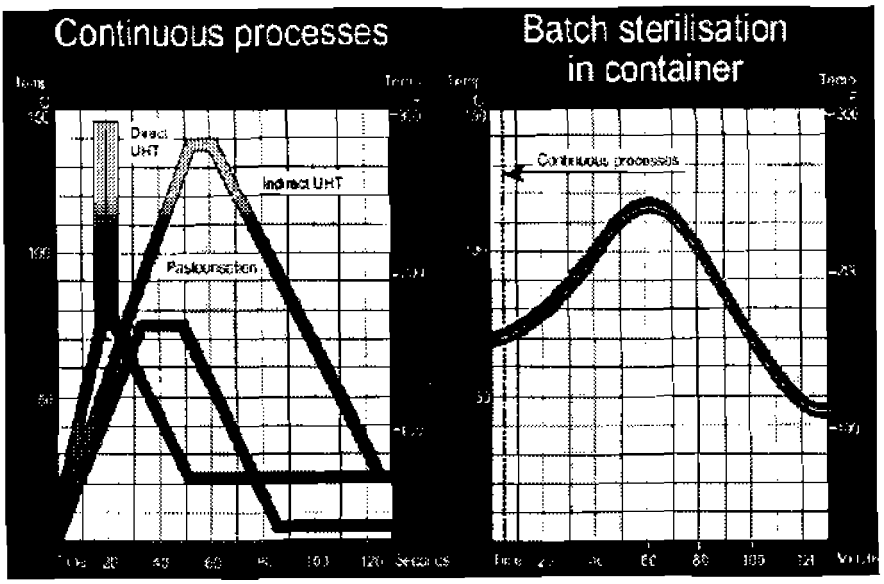

Figure 2. Direct UHT, indirect **UHT,** pasteurization, and conventional sterilization system

There are two available UHT systems, which are indirect systems and direct systems. Indirect systems usually use plate heat exchangers which is cheaper comparing to tubular heat exchangers, tubular heat exchangers which is more effective for product with particles, and scraped heat exchangers which is used for quite thick product. Comparing to indirect systems, direct system can produce higher quality of product because it has a less effect to product's nutrition. There are two systems, which are steam injection and steam infusion. Figure 2 shows the difference between direct UHT, indirect UHT, pasteurization, and conventional sterilization system. Basically, we can kill all kind of microorganisms by UHT system, except the spores. We can only force the spores in dorm condition.

To get a commercial sterile product, we also need to know the nature of the product. It can be divided into two types which are high acid product and low acid product. Product with pH below 4,6 is considered as high acid product, while product with pH above 4,6 is considered as low acid product. Naturally, high acid product has no growth of pathogenic bacteria, no spore germination, no public health risk, and can be commercial sterilized by pasteurization 90-130°C for 30 seconds. Meanwhile, low acid product is mare sensitive and can be commercial sterilized by sterilization or UHT treatment 135-140°C for 2-4 seconds. The examples of low and high acid beverage processing can *be* seen in, respectively, Figure 3 and Figure 4.

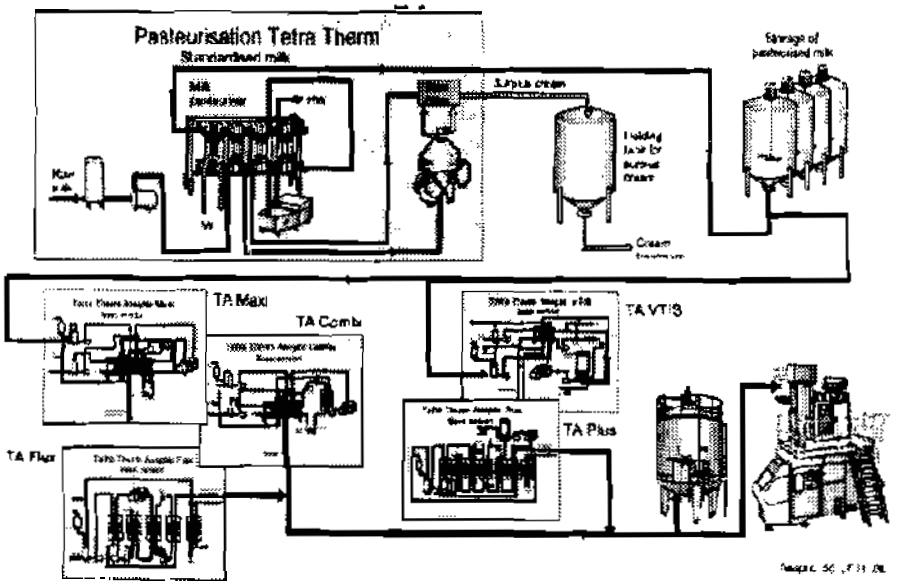

Figure 3. Technology of UHT **milk**

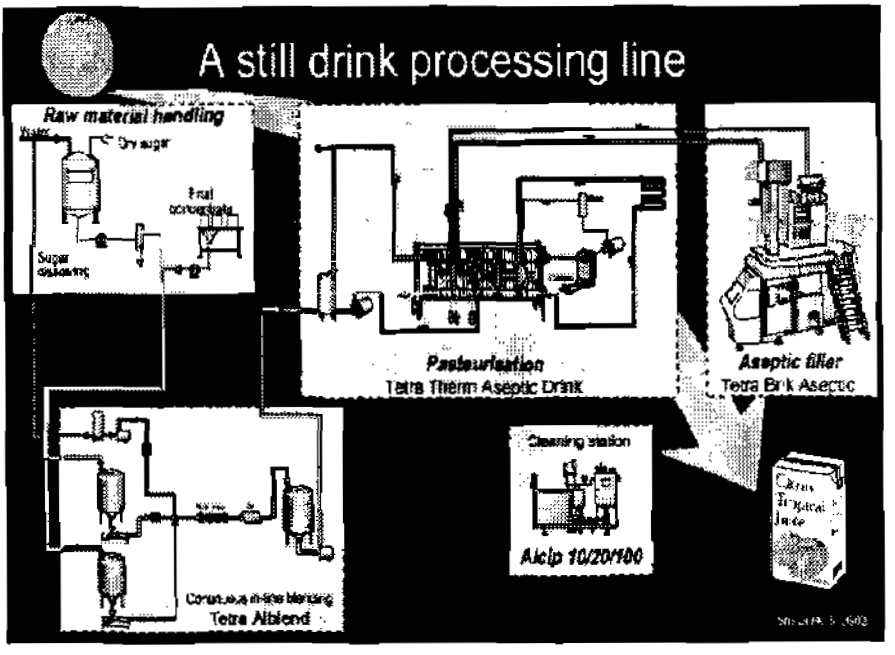

Figure 4. A still **drink** processing line

ASEPTIC PACKAGING SYSTEM

Aseptic packaging system **is a packaging process** by which microorganisms are prevented from entering into the package during filling process or after **packaging process.** This definition applies independently of the **packed product,** so aseptic packaging is possible whether the **product** is sterile or not.

Aseptic Packaging Material

Tetra Pak packaging material consist of ***6*** layers. **As** seen in Fig. 5., the first layer, from the outside, is polyethylene followed by paper, polyethylene, aluminium foil, polyethylene and **polyethylene.** Each material **that** we used in Tetra Pak **packaging** material is compliance with European Framework **Regulation** and **United States** Law & Code of Federal Regulation [FDA, 21 CFR).

Production of packaging material consists of **3 step** processes which are printing, coating, and slitting. **Packaging** material quality also determines the final product quality. To maintain the **quality,** we should **keep** the storage **premises** clean and store raw material, **packaging** material, and finished **product** separately. The temperature and **the** relative humidity should be, respectively, 10-30°C and 40-65%. The plastic wrapping should not be removed and partially **used reels should be wrapped.** Using a FIFO system, cleaning, and disinfecting hands before handling the packaging material are also important to maintain the **quality.**

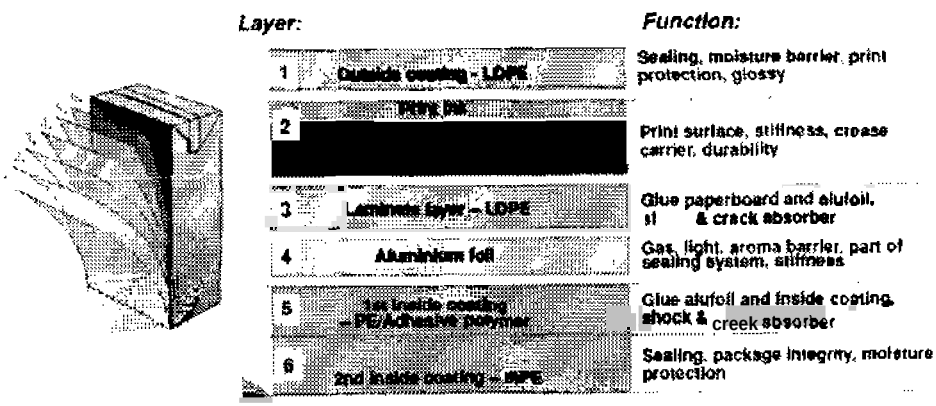

Figure 5. Tetra Pak Packaging Material

Aseptic Filling System

As seen in Fig. 6., it is the **features** of Tetra Pak filling machine. From the packaging material reels, the packaging is filled into longitudinal seal strip and hydrogen peroxide system and sealed. Sterile system in Tetra Pak filling machines can be seen in Fig. 7. Induction heating is used in sealing the **packaging.** There are two types of seal. which are transversal seal and longitudinal seal. LS-strip is applied for covering the part of sealing to ensure the liquid product does not soak **the** seal.

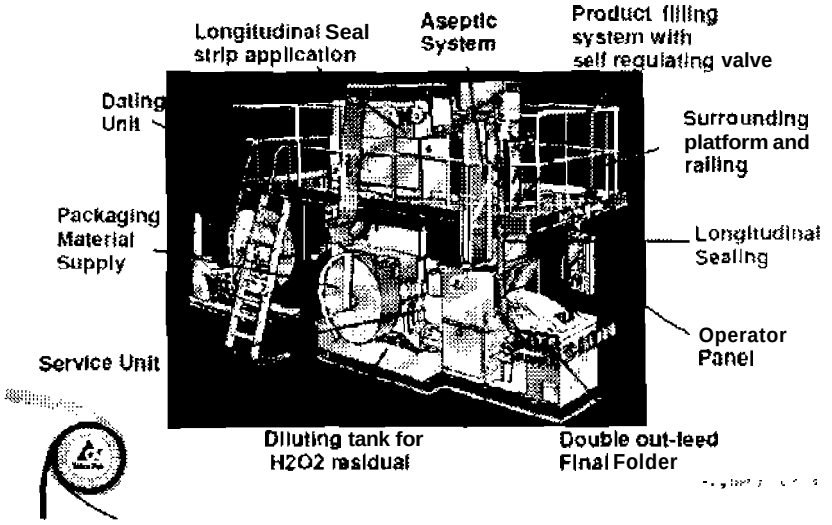

Figure *6*. Main features of Tetra Pak filling machine

The whole system is called **Tetra** Pak roll/tube concept. The benefits are saving **space** before and after filling, sterilizing whole surface of packaging material, simple filling system that gives high hygiene, totally filled packages for high product quality and good distribution, and head space possibility using inert **gas** injection that enable shaking, better pouring, and new volume creation product. Overall, the benefits of aseptic products packed in Tetra Pak packages are no need chilled **storage and** distribution, long shelf-life without any preservatives, high quality products with 'gentle' UHT heat treatment, convenience, and practical.

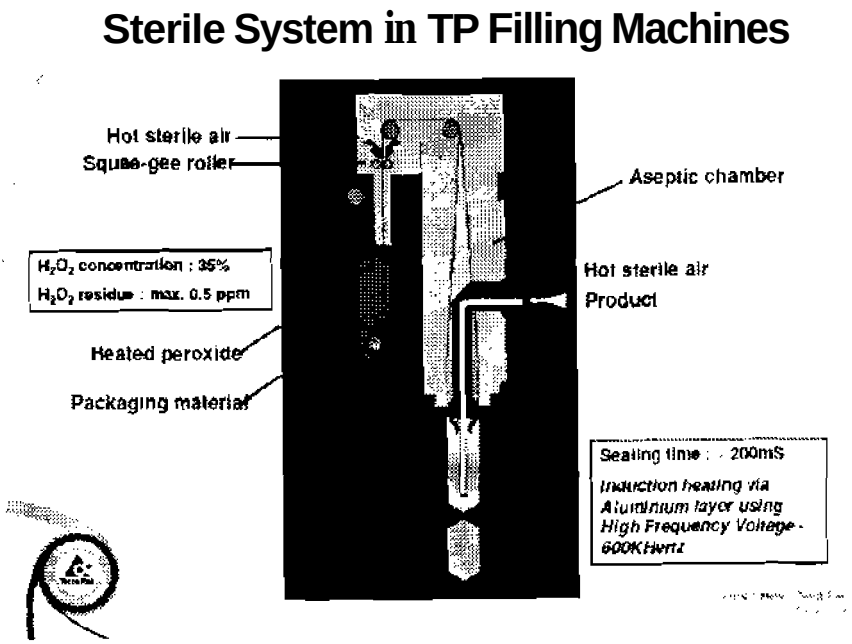

Figure 7. Sterile system in **Tetra Pak** filling machines

Quality Parameters

Hydrogen Peroxide (H_2O_2)

Hydrogen peroxide is used to **kill** bacteria in sterilization of the **packaging** material and filler. The qualification is food grade, aseptic grade, and packaging grade. The concentration of the solution is 35-50% w/w with maximum residue 0,5 ppm **on** the package.

Sterility

Sterility has to be maintained during the entire length of the intended production run. **It** is important to avoid recontamination of product and **packaging material.** Pressure in **aseptic** chamber and sufficient H_2O_2 temperature and concentration are also needed. **Sealing** supervision to ensure the production **of** tight packages is also part of **the** parameter.

Product Evaluation

The **procedure** of quality control consists of sampling and evaluation. There are **two types** of sampling, which are random (time

based) and aimed. The evaluation includes pH measurement, sensory evaluation, package integrity, and microbiological testing. **Package** integrity is quite difficult because the checking procedures are very subjective, so the test methods usually are careful visual examination, dye resting, conductivity measurement, dissolving of transversal seals, and tear down procedures.

Cleaning

There are four important parameters (four Ts) to control cleaning in place, which are temperature, time, turbulence (flow), and titration (concentration). The efficiency of mechanical or manual cleaning mainly depends on the mechanical treatment. Therefore, appropriate tools must be available. The verification of cleaning result consists of visual check, microbiological test, swab **test, and** ATP luminescence test (adenosine triphosphate bioluminescence).

*Storage, Records, **and** Documentation*

Finished product storage applies FIFO principle, positive release system, proper storage control, and suitable flooring and proper drainage. Meanwhile, record and documentation **are** essential for quick and efficient dealing with process deviations and troubleshooting.