



ESL-EGG PRODUCTS: THE FUTURE



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Today most of the eggs are still sold as shell eggs, but since several years now the use of processed eggs is increasing considerably. It is estimated that in Europe between 20 and 25 % are transformed into egg products and it is expected that by the year 2005 this figure might be between 30 % and 35 %.

In the U.S.A. the actual percentage is already more than 30 % and according insiders this figure will be close to 50 % by 2010.



Unfortunately the egg products do not add to the total egg consumption but they are replacing the consumption of the eggs in shells. The food industry replaced their purchases of shell eggs by egg products because:

- egg breaking is labour intensive
- strict governmental regulations require special facilities and machinery
- it will increase their waste problems (eggshells, washing water, etc.)
- daily variation of the prices of shells eggs requires expertise
- egg products are easier to store
- egg products are easier to use
- in some cases they only need either the egg white or the egg yolk

The most important users are:

- in the food industry: the manufacturers of baby foods, biscuits, cakes, cake mixes, candy, chocolate, cookies, confectionary, custard, dressings, egg liqueur, ham, fish cake, ice cream, macaroni, marshmallows, mayonnaise, meat preparations, noodles, omelets, prepared meals, puddings, sauces, soups, spaghetti, tarts, wine
- in medical and cosmetic industry: detergents, shampoo, lecithine, lipsticks, moisturising creams.
- for technical purposes in the leather industry, paints
- the egg shells are used in the animal feed industry as calcium source or they are also mixed with fertilizers



More recently and because of the frequent deadly accidents caused by salmonella infection now also the

catering industry prefers to use pasteurised egg products which are guaranteed free of salmonella and other pathogenic bacteria.

In some countries such as Spain and the U.S.A. the use of pasteurised egg products became compulsory for hotels, restaurants, hospitals and airline catering, which created new outlets for refrigerated Extended Shelf Life (ESL) egg products.



For the production of ESL egg products the processors had to invest heavily in order to extend the normal shelf life of a pasteurised egg products (3/4 days) to 5/6 weeks or even 10/12 weeks in order to make distribution economically possible. The buildings and the complete production line starting from the supply of shell eggs until the delivery in refrigerated trucks has to be

renewed in order to bring it up to the highest degree of hygiene in order to come as close as possible to sterility.

The 1 and 2 litres gable top cartons and the "bag in box" cartons are used by the artisanal bakeries, butchers, ice cream salons, restaurants, hospitals, etc.

The smaller packs of 1/4 and 1/2 litre are for direct consumption. Already today in the U.S.A. you can find these packs in the supermarket next to the shell eggs in refrigerated counters

We expect to see a wide range of products offered besides the normal whole egg, egg white and egg yolk, such as scrambled eggs, omelettes with ham, bacon, herbs, mushrooms, etc. Also diet egg products with low cholesterol, low fat and cake mixes. This might be a turn point in the distribution of eggs and more or less like we have seen it happen over the last decades for milk, with the diversification into a wide range of products like yoghurts and desserts and supported by publicity campaigns in the press and TV.



Extended shelf life egg product (ESL)



ESL egg products are normal egg products to which special care has been given during processing in order to reduce their bacteria count to a strict minimum and as close as possible to sterility and to obtain an extended shelf life.

In order to achieve this only good fresh quality eggs can be used and are processed on breaking machines causing the smallest possible bacteriological contamination, special and hygienic techniques are used for filtering, cooling and storage before pasteurisation, special UHT (Ultra High Temperature) pasteurising equipment, aseptic storage tanks prior to packing and packed with aseptic machines in packages of 1/4, 1/2, 1, 2 litre gable top cartons or 3 up to 30 litre "bag in box" cartons or even into big bags of 500 and 1000 litres.

Actually with this technology a refrigerated shelf life of 5/6 weeks can be achieved in "bag in box" cartons and 10/12 weeks in the small gable top cartons.

The building:

The building must have a finishing for easy cleaning and allow for the most strict hygiene, with strict separation of sterile, clean and dirty rooms without direct communication.

Facilities for washing, disinfection and change clothing must be provided before entering clean and sterile rooms.

The air intake through HEPA-filters with a controlled flow from the sterile room towards the clean and then the dirty areas in order to avoid cross contamination.

The shell eggs:

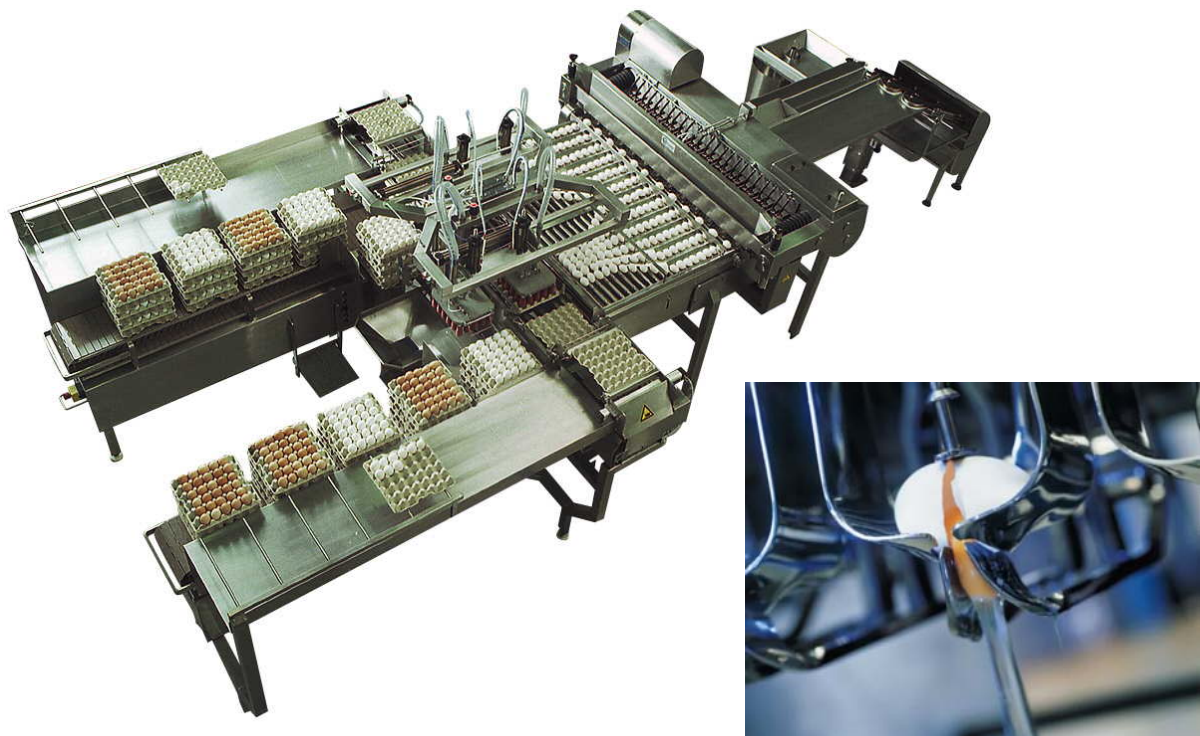
For the production of ESL egg products only first quality and very fresh eggs can be used. With such eggs of which the content is practically sterile the total count after breaking, filtering, cooling and storage for standardisation prior to pasteurisation can be with a total count of <20.000 per gram. In any case egg products with an higher count than 100.000 per gram should not be used for ESL because in order to reduce such total

counts to acceptable limits more severe pasteurising conditions have to be applied which will reduce considerably the functional properties of the product which will make it unacceptable for most of the users.

Egg washing:

Unlike in the U.S.A. egg washing in Europe is not compulsory and only for dirty eggs washing is required. The necessity to wash eggs before breaking is still the matter for discussion. It is in fact possible that while washing the bacteria present on the outside of the shells is pushed through the shell wall by the action of the brushes. In any case if egg washers are used great care must be given to the kind of equipment. It is preferable to use the model whereby the washing water is not recirculated and in any case after washing the eggs must be sprayed with a disinfectant and be as dry as possible before they reach the breakers.

Egg breaking:



The egg breaking machine with the smallest contamination should be selected. For this purpose following points should be considered: - all eggs should be loaded into the breaking heads of the machine, in order to avoid that half broken eggs and their shells contaminate the egg products.

- the eggs shells should be removed immediately after breaking towards the loading area or directly into inedible room for further treatment or disposal. The presence of the shells above the product will pollute the product and the air inside the processing area.
- the time of exposure and surface of product exposed to the air should be limited. In a gutter system both of these conditions are realised as opposed to a cup system whereby the cups are always polluted by products remaining

on its surface and permanently exposed to polluted air, because of the presence of the highly contaminated shells. While breaking, the egg content may not be in contact with the outer side of the shells.

Obviously the yield of breaking should be maintained at about 84 % taking in account the losses for the shells itself, unbroken eggs and the egg white adhering to the shell walls.

The temperature of the shell eggs should not be lower than $16^{\circ} C$ in order to obtain a maximum yield. With colder eggs more egg white will adhere to the shell walls and the loss of product with the shells will increase.

The best results can be achieved when the eggs are stored at about $8^{\circ} C$, and the day before breaking the eggs are put at room temperature. In such way the outer side of the eggs will have room temperature and the egg yolk being in the center will still be cold and separate easily from the warmer and more liquid egg whites.



With good quality eggs, the separation of yolks and whites can be 100 %, since only broken yolks are removed before the separation gutters and are in a later stage again added to the yolks which are separated from the whites.

On any type of machine the dripping time is of less importance because the presence of the knives into the shells will prevent the egg white to come out of the shells.

Furthermore the cleaning and disinfection of the breaking machine should be easy.

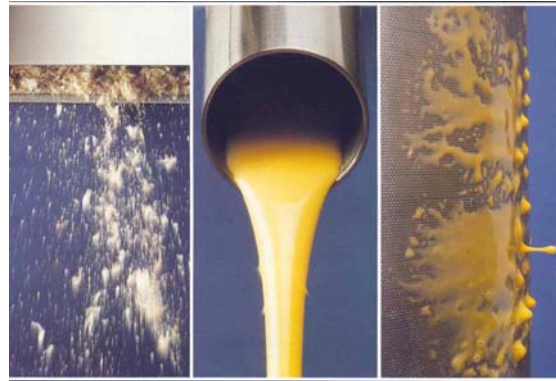
On the Coenraadts egg breaking and separating machine all these conditions are fulfilled and therefore widely used in the EEC especially by the processors of ESL egg products.

Product reception:

After breaking the product should be evacuated as quick as possible in order to reduce the time it is exposed to the air at room temperature. Therefore the reception tanks should be small and closed. A level switch will start and stop the pumping respectively when a the maximum or minimum level is reached. Cleaning and disinfection of these reception tanks must be easy.

Filtering:

The selection of the filters is very important since they are very often the cause of bacteriological contamination. We strongly recommend the automatic pneumatically operated filters of which the filtrate can be easily evacuated during the production with a minimum loss of product. These filters can operate non-stop with intermediate cleaning and rinsing, this will reduce considerably the bacteriological contamination. C.I.P. cleaning and disinfection in line are possible.



Pumps:



In order not to reduce the functional properties of the egg products the centrifugal pumps cannot be used. We recommend the ultra-clean, air operated piston pumps, because of the gentle way they handle the product, their relatively low price and they can be cleaned in-line the C.I.P. circuit, using a by-pass. The pumps are built into a stainless steel cabinet on high feet so that the floor underneath can be cleaned easily. Another advantage of these air operated pumps is the absence of electricity in this wet environment which is an important safety factor for the operators. These pumps are installed after the filters and will pull the products from the reception tanks through the filters and push them through the coolers into the storage tanks for raw products.

Cooling:

After breaking the product should be cooled as fast as possible to below 5°C. in order to stop bacteriological growth. For this purpose



either plate or tubular coolers can be used. The cooling capacity must be calculated according to the selected pump speed.

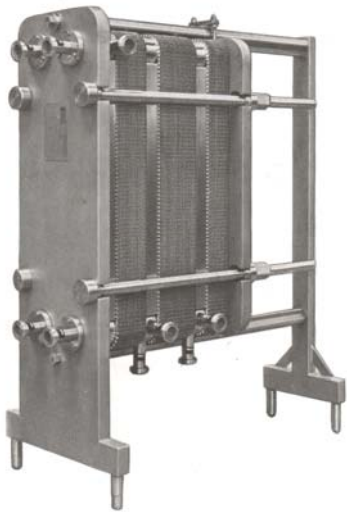


Plate cooler

Tube cooler

Storage tanks:

The temperature of the raw egg products must be maintained as low as possible until pasteurisation in closed refrigerated and insulated vertical stainless steel tanks.



Their capacity will be calculated in function of the production capacity of the plant and equipped with: - an agitator in order to maintain the product in suspension and to have a good cooling efficiency through the contact with the cold wall of the tank. If at this level sugar or salt are added the agitator should be replaced by a mixer with variable speeds and an adapted design of the propellers according to the kind and quantity of product which has to be

incorporated. If salt is added the stainless steel quality in contact with the product should be type 316.

- a dosing pump for bringing the solid content of the whole egg or egg yolk to the required standards
 - manhole with view port for inspection. The manhole must always be closed when product is inside.
 - light for inspection through the glass port
 - air inlet, to prevent damage because vacuum while emptying the tank.
 - level control,' several systems are available with sensors or weight.
- It is important to select a system which is easy to clean and will not be the cause of bacteriological contamination.
- C.I.P. system for cleaning in line. The spraying device should be selected so that each part of the inside of the tanks will be reached with the cleaning solution and with sufficient pressure in order to achieve a perfect cleaning and disinfection.

Mixing:

When a high percentage of salt or other ingredients which are difficult to dissolve have to be incorporated a special heavy duty mixer should be used.

Homogenisation:



HOMOGENIZER H 3015

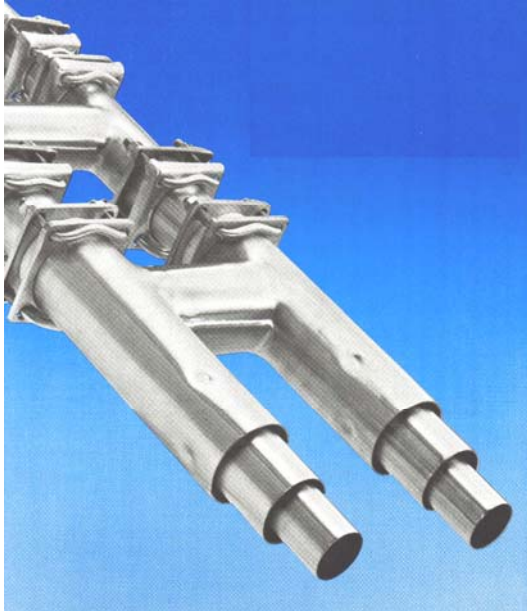
It is very important to have the egg products homogenised before the pasteurisation, especially whole egg. Especially fresh egg white will mix very difficultly with the egg yolk and it requires a specially adapted homogeniser for egg products to obtain a perfect blend. Without homogenising the pure egg white will coagulate more rapidly than the yolk and will be the cause of coagulated

particles in the end product with as a result precipitate in the final packing and partial loss of the functional properties of the egg. Because of the coagulation the pasteurizer will need more often to be stopped for cleaning with as a result loss of product and precious time.

The homogenizer will also reduce the particle size and facilitate the heat penetration and therefore a more effective killing of bacteria.

It is also possible to pasteurise at higher temperatures (up to 72' C) without causing any damage to the functional properties of the egg product. Because of the smaller particle size the taste and flavour will be more pronounced and less egg product will be required for certain preparations.

UHT Pasteurisation:



Specially for the ESL egg products a triple tube pasteurizer with turbulent stream was designed. All controls have been modified and adapted so that it becomes possible to pasteurise at high temperatures (up to 72' C with homogenised product) with a limited holding time of 1 00 seconds for whole egg. A minimum pasteurisation time of 7 hours is guaranteed and a bacteriological reduction of 10x more than with the classical plate pasteurizers.

With a good quality of eggs, and taking in account the recommendations above the total bacteria count per gram should be less than 50.000 (in recent projects we achieve an average of less than 20.000) after UHT pasteurisation all bacteriological tests are negative.

The product will leave the pasteurizer at 2' C or less.



Aseptic (ultra clean) storage:

After pasteurisation the product is transferred into an aseptic,

refrigerated, insulated storage tank, and equipped as the tanks for raw product.

Additionally a sterile air filter must be fitted and facilities for sterilisation after cip cleaning.

The product should be kept at a temperature of 2' C or less.

Packing:

For the ESL packing special and aseptic filling equipment will be required. Since the products have to be kept under refrigeration at all time we think it is better to have a gable type of packing for the small cartons from 1/4 to 2 litre. With ELOPAK ESL-machines combining features as HEPA air filters, use of sterilised cartons, UV and Ultra heated air, CIP cleaning and steam sterilisation can provide shelf life up to 10/12 weeks.



With the "bag in box" type of packing, with the "Van Meurs" ESL-machine a shelf life up to 8 weeks can be achieved in carton sizes from 3 to 30 kg.

It is important to maintain the temperature during packing as low as possible and certainly not higher than +40 C.

Storage of end products:

It is very important that the products immediately after being packed are transferred to the cold store and kept at a temperature of maximum +2° C.

The products should be stored per lot number and the handling should be based on "first in/first out".

Piping:

During installation great care must be given to the finishing of the stainless steel in general and especially to the welding so that they have a smooth finishing and will be easy to clean with the C.I.P. system.

If the distance of transport towards the packing machine is long, the piping should be insulated or even refrigerated with ice water, so that the product during eventual production stops will not warm up.

C.I.P. Cleaning:

An automatic or semi-automatic C.I.P. system should be selected with different programs for cleaning tanks, piping, or tote tanks. Good cleaning is vital for the success of a ESL egg products line.

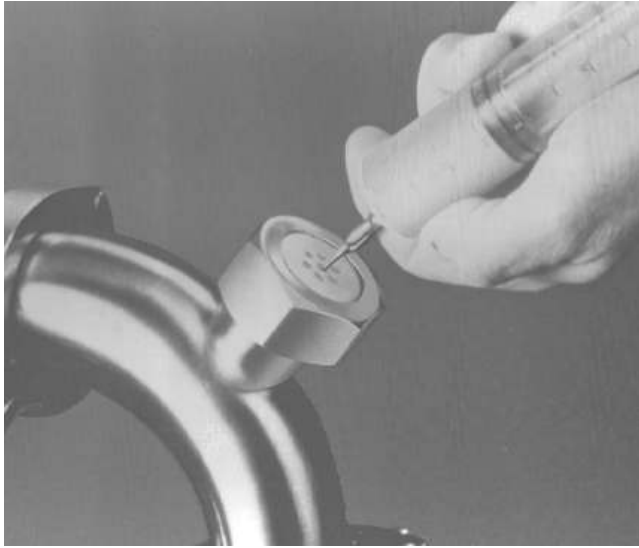


Compressed air:

A compressor should be selected in order to provide clean, fresh and dry compressed air at sufficient pressure and volume. The location of the airdrier may not be too far away from the point where the air is used, otherwise condensation will occur.

Sampling and control:

In order to follow up the process and to detect eventual the origins of infection it will be necessary to have at strategic locations aseptic samplers.



Laboratory:

The egg products must be tested on their physical, chemical and



bacteriological quality in order to have standardized products up to the requirements.

Specially for the ESL egg products the bacteriological quality must be tested at several production levels:

- the shells eggs - the products immediatly after breaking - before pasteurization - after pasteurization - before packing - after packing -

each week on the sample pack(s) kept as witness

Following bacteriological test should be made: - total bacteria count

- enterobacteria
- coliform
- E. coli
- Staphylococcus aureus
- salmonella

If after packing an abnormal presence is found, it will benecessary to locate the source of contamination.

Distribution:

At all time the ESL-egg products should be kept under refrigerated conditions (possibly +2' C and in any case less than +4' C) during storage

and transport. It is also very important that the user has a storing facilities at these conditions.

To obtain ESL-egg products it is very important that each section of the production line should be up to the highest possible hygienic standards, the personnel must have the correct mental approach and greatest care must be given to the' quality of the raw material.

Filiep Van Bosstraeten is Director and General Manager of Ovobel Ltd, 93. Bilkske. 8000 Brugge, Belgium. He has more than 40 years practical experience in the egg processing industry and has been involved in the planning, the supply of machinery and equipment, the erection and the management of a large number of.projects in this field on a world wide scale.