

Egg Products Process and Plant Familiarization

Objectives

After completing this section, the participant will be able to:

1. Explain the processes used by plants to produce egg products.
2. Identify some of the equipment used in egg products processing.

Introduction

As egg products regulators, we must have a general understanding of the processes that the industry uses to produce egg products. Understanding the processes and equipment involved in handling egg products will help inspectors to perform verification procedures. This module gives an overview of these processes and the science that applies to food safety.

As a reminder, the term “egg products” refers to eggs that are removed from their shells for processing. Egg products processing includes breaking eggs, filtering, mixing, stabilizing, blending, pasteurizing, cooling, freezing or drying, and packaging. Egg products include whole eggs, whites, yolks, and various processed and pasteurized blends, with or without non-egg ingredients. These egg products may be available in liquid, frozen, and dried forms.

The design of the production facilities must provide flexibility and efficiency to accommodate the specific processes required for producing different egg products. Some plants also have shell egg grading facilities and dual jurisdiction activities such as cooking and hard-boiled operations in the egg products facility.

Egg Products Processing

The processing of egg products includes:

- receiving shell eggs
- washing/sanitizing/candling eggs
- breaking eggs
- handling liquid egg product:
 - filtering
 - blending
 - mixing
- cooling
- pasteurization

- freezing or drying
- packaging
- storage
- shipping

We will briefly walk through each of these areas as an introduction to egg processing. We will discuss this information in more detail later in the material.

Receiving Eggs

Eggs are transported to the plant directly from either laying hens or contract flocks, or both (See Appendix I – Figure 1).

When eggs come directly from the egg-laying farm to the egg breaking or processing plant, they are called in-line operations. There is a very short time between when the eggs are laid and when they reach the egg processing plant. Most new complexes are in-line systems designed to move eggs directly on conveyors from laying houses to the processing area. The eggs presented for breaking in these operations are called “nest run”. The nest run are eggs that have never been sized, washed, or graded. A high percentage of the eggs gathered by this method are first-rate quality, if good flock-management practices are in place.

Another way of delivering eggs is in filler-flats (off-line systems) that come from contract flocks. Contract flocks are chicken houses that the company contracts to furnish eggs. The eggs from off-line systems can come from multiple chicken farms and there may be a lot of variability (hours to days to weeks) in the age of the eggs. Eggs are packed in plastic filler-flats, palletized, and transported to the processing facility. These plastic flats are to be thoroughly cleaned, sanitized, and dried after each use to avoid cross-contamination and the creation of insanitary conditions. The proper handling of eggs is important, as it helps to prevent egg damage, minimizes any quality loss, and avoids compromising the safety of the egg.

In egg-breaking plants, the production starts with the loading of eggs as either in-line operations or off-line systems. In off-line systems, once the egg filler-flats or nest-run eggs arrive in the transfer room, flats of eggs are loaded to the off-line conveyors and moved to conveyor spools going through the egg washers.

Washing Eggs and Sanitizing

Shell eggs, when presented for breaking, must be clean.

Modern egg washers use pressure sprays, rotating brushes, and an egg-spinning device that increases contact between the egg and the brush and minimizes damage to the eggs.

Plant personnel segregate shell eggs ineligible for breaking during the candling operation. Shell eggs continue on the conveyor to the breaking room.

Candling Eggs

In the candling process, eggs are mechanically rotated several times over a bright light to examine the internal quality of the egg. The primary function of the candling procedure is to remove the dirty or cracked, and ineligible eggs before the breaking step. This is a critical step in the processing of the shell eggs. Egg products plants may have more than one candling area (before and after the washer), depending on the segregation procedures, eggshell quality and classifications, and conveyor speed.

Plant employees sort, classify, and segregate the eggs to ensure that only eggs eligible for breaking enter the breaking room. During segregation, the employees will remove inedible eggs. To prevent interruption of the breaking operation, employees may replace any dirty, leaker, inedible or loss eggs with clean and sound shell eggs.

Breaking Eggs

In breaking room facilities and operations, shell eggs are broken and the liquid is separated from the shells. After the egg is broken, the breaking machine can separate the yolk from the white.

Liquid Egg Product Handling

After breaking, the liquid egg flows into collection vats (balance tanks) by gravity. A perforated plate contained within the vat serves as a filter to remove eggshells. The liquid egg is pumped through a filter and then is pumped to the cooling system. After cooling, the liquid egg is pumped to a storage silo for further processing.

Further Processing

As a reminder, as per 9 CFR 590.504(e), pasteurization, stabilization, or drying operations shall start as soon as practicable after breaking to prevent deterioration of product, preferably within 72 hours from time of breaking for egg products other than whites which are to be desugared.

This section gives a brief overview of further processing techniques. Let us start with the pasteurization process.

Appendix 1 – Figure 5 demonstrates a flow diagram of liquid egg product for further processing.

Pasteurization

The Egg Product Inspection Act requires that all egg products distributed into commerce be pasteurized. Pasteurization involves rapidly heating the product and holding the product at a minimum required temperature for a specific time. The reason for pasteurization is to destroy *Salmonella* without affecting the characteristics of the final egg product.

Two common types of pasteurization are high temperature-short time (HTST) pasteurization and batch pasteurization. In this training, we will focus on HTST pasteurization. Batch pasteurization is no longer used.

After pasteurization, it is essential to handle the pasteurized egg product in a sanitary manner to prevent cross-contamination. The pasteurized liquid product may be handled as follows:

- packed in containers (plastic buckets, bag-in-box, packages, milk containers, etc.) to be marketed
- further processed (add ingredients post pasteurization, freeze or dry)
- shipped in tankers to another egg products plant or distributor

Appendix 1 – Figure 2 shows the flow diagram for pasteurized liquid and frozen egg products.

Freezing

Frozen egg products include separated whites and yolks, whole eggs, blends of whole eggs and yolks, and whole eggs with added ingredients. They are produced from pasteurized liquid egg products by using a blast freezer at temperatures of -10°F to -40°F . Frozen egg products have a long shelf life when kept at less than 10°F .

Drying

Industry has developed a variety of dried egg products, including dried egg white, dried plain whole egg and yolk, and specialty dried egg products.

Egg products fall under two basic categories when considering their drying characteristics:

- * egg white products
- * whole egg and yolk products

Before the liquid egg products go through the drying process, industry uses processing techniques to achieve the desired finished product. These techniques alter the composition of egg components by changing the lipid or sugar composition, concentrating solids, or separating egg components (e.g., lysozyme and avidin).

The two common methods that industry uses to produce dried egg products are:

- Spray drying – atomized liquid egg product is sprayed into a stream of hot air, collected and packaged. This is the predominant method used by the dried egg product industry. Spray drying does not kill microorganisms. However, it does extend product shelf life.
- Pan drying or albumen flake process – unpasteurized egg whites are dried on pans to produce a flake-type or granular material. This method is used for the confectionary industry.

Another method of drying is the Refractance Window[®] drying system. This operation is a low temperature drying technique, which removes moisture from high moisture products that generally vary in solid content between 3% and 70%. Briefly, the operation consists of:

- Slurry of liquid is evenly applied to the top surface of a continuous sheet of transparent plastic.
- This continuous plastic film slowly moves across a hot water reservoir (210° F) which provides an infrared energy source (i.e., infrared energy and conducted heat) permitting the rapid drying at atmospheric pressure rather than under vacuum.
- Results in dry flakes on the opposite end and the process provides retention of the egg product's functional properties and nutritional value.

This type of drying is very uncommon. Currently, only one egg products plant in the U.S. uses this type of drying process.

Industry uses chemical additives to improve and keep the functional properties (whipping, coagulation, emulsification, flavor, nutrition, and color) of the final dried egg products. Examples of chemical additives include carbohydrates, whipping aids, emulsifiers, and anti-caking agents (colloidal silicon dioxide).

The dried egg product must be handled aseptically during packaging. The advantages of dried egg products compared to their liquid frozen counterparts are shelf life, storage, and low transportation costs. (See Appendix 1 – Figures 3 and 4)

Appendix I – Flow Diagrams

Figure 1: Source of Egg Breaking Stocks

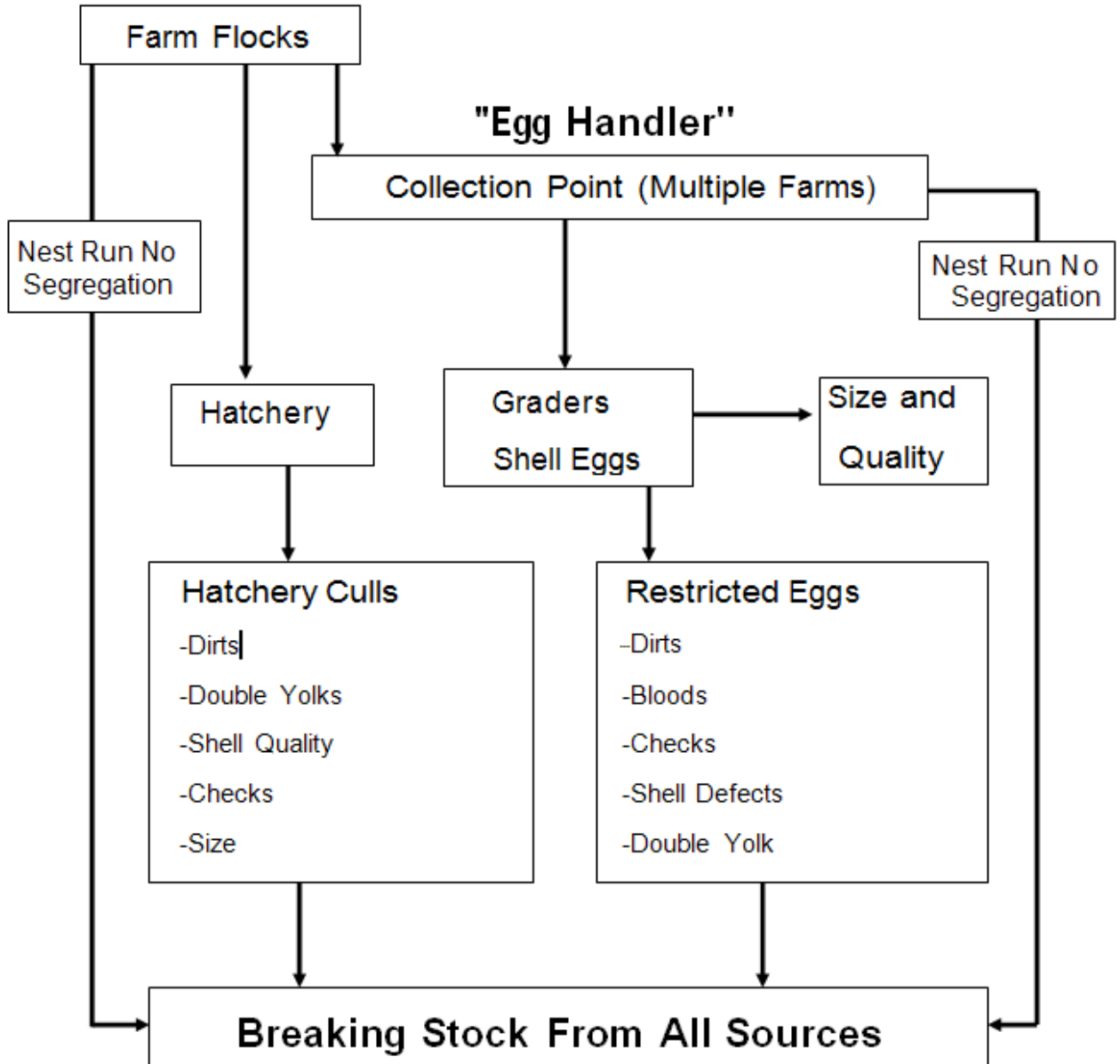


Figure 2: Flow Diagram – Pasteurized Liquid/Frozen Egg Products

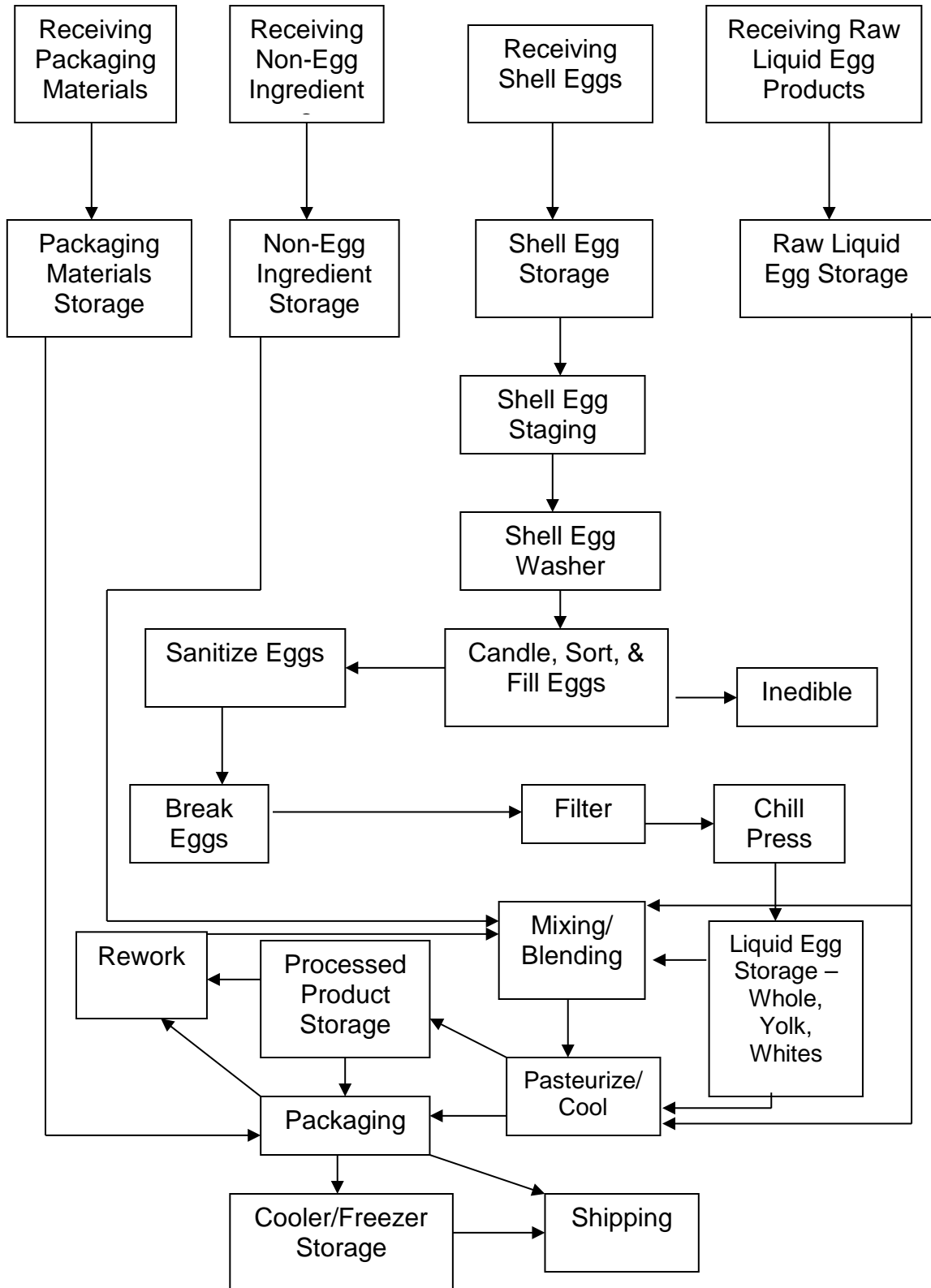


Figure 3: Flow Diagram – Pasteurized Dried Egg Whites

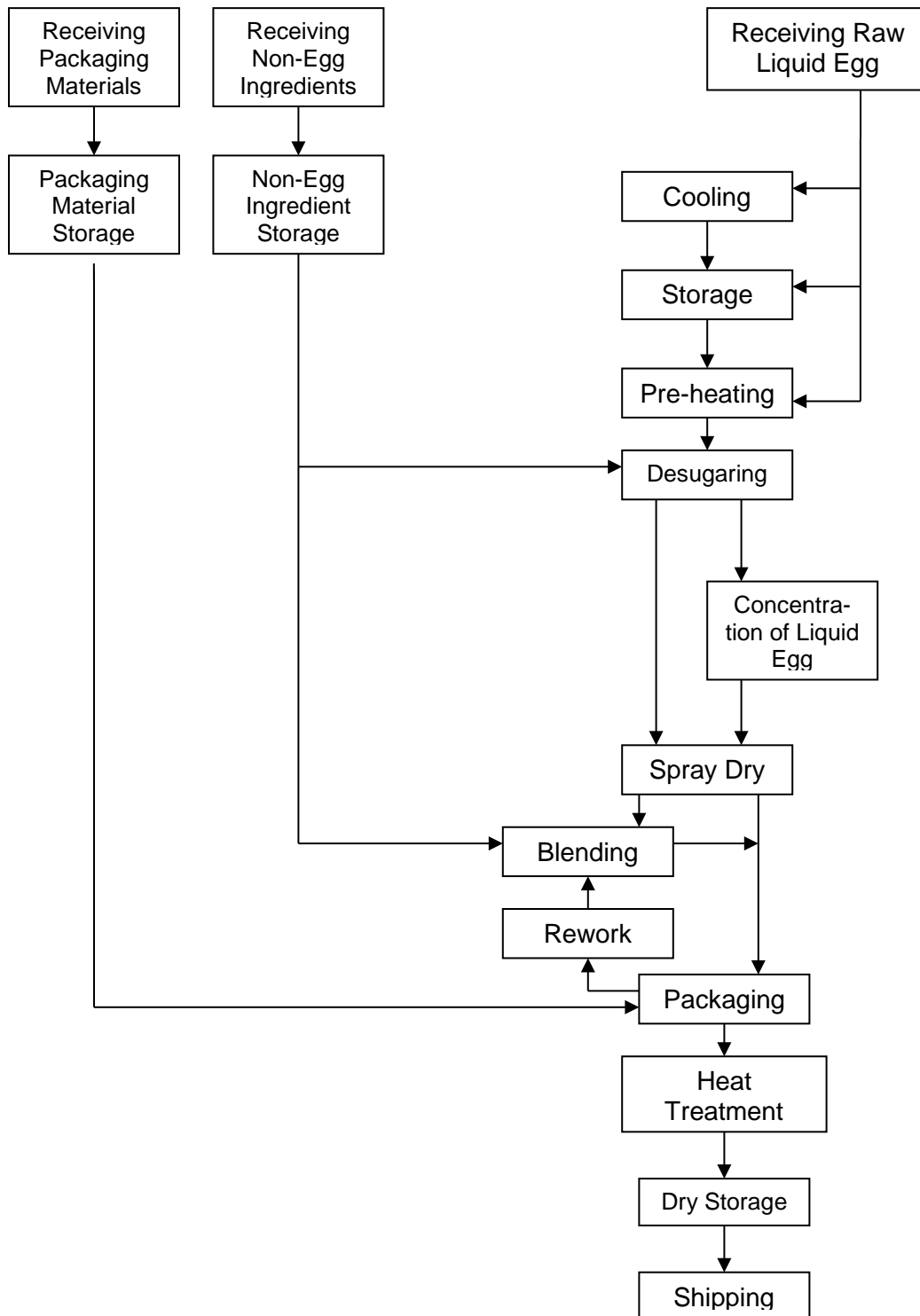


Figure 4: Flow Diagram – Pasteurized Dried Yellow Egg Products

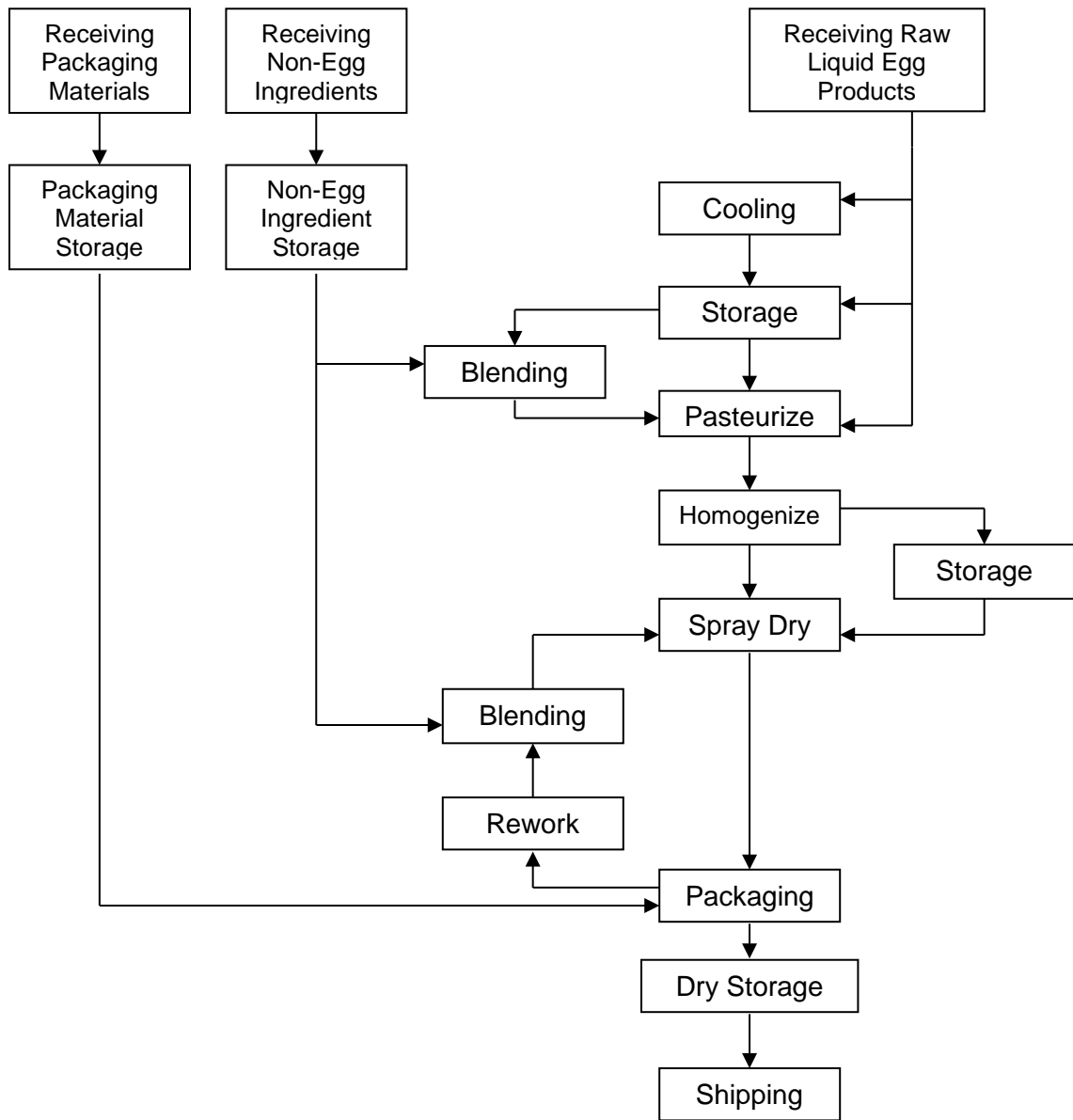
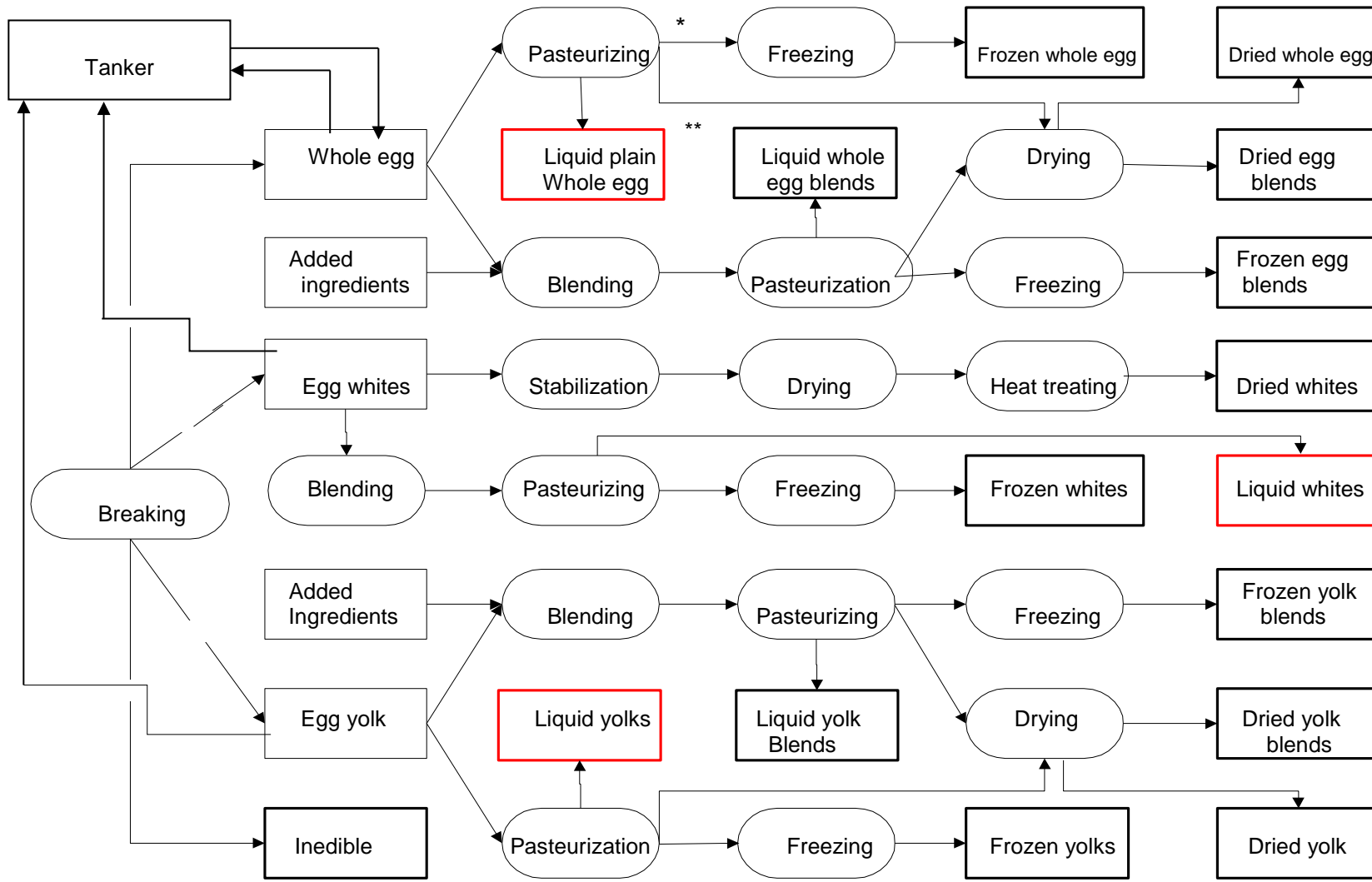


Figure 5: Liquid Egg Product Flow



*Ovals represent the process
** Squares represent the egg product