CHAPTER II
LITERATURE REVIEW

2.1 Foi-tong

2.1.1 Factors affecting the quality of Foi-tong
(S. Chaochumnan , 1990)

Ms. Chaochumnan, completed her studies with a research of "*Factors Affecting the Quality of Foi-Tong and its Shelf life* "She prepared egg emulsion under several conditions such as from the eggs stored at room temperature (30-35 C) for 2, 4, 6, 8 and 10 days. The different concentration of syrup started with 50, 60 and 70 %. The egg ratio (duck :hen) could also effect the quality of foi-tong. She mixed at the ratio of 100:0, 80:20, 40:60, and 20:80. The mixtures of those egg yolks were mixed factorial with 5, 10, 15, 20 and 25 % of outer thin albumen and cooked in the boiling predetermined concentration of syrup. She mixed at 3 and 6 %of the vegetable oil in the yolk mixture for the good appearance of Foi-tong (to look shiny). Foi-tong so obtained was packed in LDPE, HDPE, PP bags, PVC box and PS foam at 15 C. The result indicated that increasing of storage time of eggs trend to decrease the strength in Kg/cm of Foi-tong and unacceptable by the taste panel. The increasing of concentration resulted in more sweetness of Foi-tong and its strength, but less in its glossiness. In this thesis was involved only with the strength in Kg/cm.

2.1.2 Egg and its properties

Egg is the raw material for cooking Foi-tong. It is very essential to study its properties. Because the egg emulsion has individual characteristic to flow through small hole into the syrup. The quality of shape configuration is mostly depend on egg yolk. **Belitz, and Grosch, 1987,** had studied and knew that one egg consists of egg shell 10.33% albumen 56.85; egg yolk 32.8%. This background can support the egg preparation before start doing viscosity, friction ,resistance and compression tests.

Albumen : There are two parts of albumen, the first part thick albumen and thin albumen. Total albumen consists of 4 portions, namely chalaziferous 2.7% ; inner thin albumen 16.8 % thick albumen 57.3 and outer thin albumen 23. 2 % **(Suwan, 1986; Romanoff 1949: Stadelmar A. Cotterill, 1977)** the outer thin albumen mixture is too much, the consequence is the shape of the string will spread-out . The string became, then the flat string. **(Janya, 1987)**

Egg yolk : Egg yolk consists of three main parts: vitelline membrance, germinal dice and yolk. **(Carter, 1968).** The duck egg yolk consists of water, protein, fat, carbohydrate and organic substances in ratio of: 44.8, 17.7, 35.2, 1.1, 1.2 and the hen egg in ratio of 48.7, 16.6, 32.6, 1.0 and 1.1 respectively. The preferred ratio between duck egg yolk: hen egg yolk in average ratio of 80:20 **(Tong-yu, 1980; Watcharipun, 1981; Wandee, 1981; Janya, 1984)**

2.1.3 Heat effect on potein in egg

Denaturation of potein in heating is clearly noticeable. It will form like a chunk of cheese in a coagulation process. Such denaturation is caused by the molecule of the potein is enlarging while it is being heated. The molecule of the potein is polypeptide with a hydrogen bond, hydrophobic bond and ionic bond. Potein is therefore relaxed from the initial condition because all conditions have been demolished except; the polypeptide **(Nuchree, 1986; Vail and team, 1973).**

2.1.4. Syrup Concentration

Syrup for cooking Foi-tong must have enough concentration in order to observe the water from egg emulsion and let the emulsion configurate in a round string shape. **(Janya, 1984; Wanipa, 1985).** The most appropriate syrup concentration is between 50-70% **(Training Centre and Bankok Vocational Advisory Center 1977; Thong-yu, 1980; Chantorn and team, 1981; Watcharee, 1981; Wanni 1981; Wannipa 1985.)**

The average concentration is around 60% . The water boiling temperature of the syrup with 60 % concentration is 103° C. This boiling temperature is directly proportional to the concentration . **(Charley,1872)**

2.1.5. Vegetable oil

Vegetable oil is a compounded substance of trigleceride. It softens the food and also acts as lubricant. It is a medium for heat transfer. Because the oil can good prostate therefore it is able to enamel the product, to look shiny **(Charley, 1982)**. Normally, the mixture of egg yolk is about 3% . **(Janya, 1984)**

2.2. Basic theory survey

2.2.1. Fluid mechanics

2.2.1.1 Definitions

Some relevant physical concepts are very necessary to servey, some knowledge to apply for solving the thesis problem statement, such as

Viscosity: Viscosity can be thought as a stickiness of a fluid. It can control the flow of the fluid through pipe line or any through hole during a specific period of time **(Merle C. Potter , David C. Wiggert, 1997).** It accounts for the energy losses during the transporting of the fluid. Therefore, viscosity is an important physical concept which has to be studied . The viscosity can be defined by the relationship

$$\tau = \mu * du / dy$$

Where , τ is the shear stress, in [Pa].
u is velocity in x- direction, [m/s]
μ is the viscosity ,in [$N.s/m^2$].

The experiment need to be setup in the chemical laboratory. The other related fluid property is to concluded here is the consideration what type of the liquid the egg emulsion can be classified. As a **Newtonian fluid** . the relation between the shear stress τ and the strain rate **du / dy is in direct proportional.** For example water, air and oil . Above the Newtonian line , the curve is progressive, called Non-Newtonian (dilatant : quicksand, slurries) become more resistant to flow as the strain rate increases. While the degressive curve ,under the Newtonian line, called non-Newtonian - pseudoplastic, Ideal plastic or Bingham fluid (e.g. clay suspension , toothpaste). Such a fluid requires a minimum shear rate to cause motion .

The concept of viscosity and velocity gradients can also be defined by observing the fluid in between small gap of two concentric cylinders. The inner rotate cylinder at a constant speed while the outer cylinder containing egg-emulsion remains stationary. The occurring resistance is due to viscosity which can affect on the egg emulsion flow through the rilling hole.

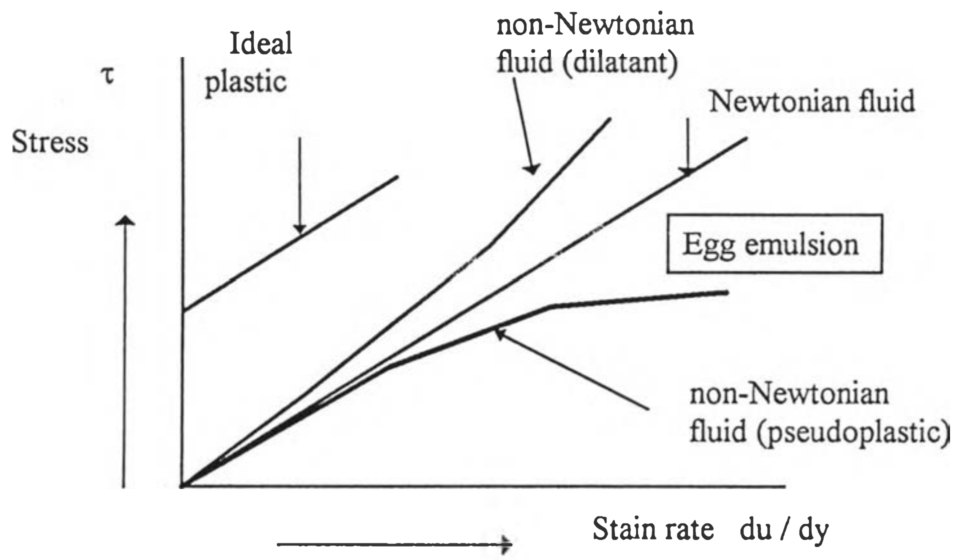


Figure 2.1 Newtonian and non-Newtonian fluids

Friction : The relationship between the metal surface and the fluid surface is also very important. The friction force in between is the obstacle of flow. It can effect both in the cold or warm condition. The surface tension of the fluid is to considered before decide to select a material for its container. Friction appears in boundary layers because the work done by shear forces in maintaining the velocity gradient in both laminar and turbulent flow is converted into heat.

Pressure: The atmospheric problem has a very big roll in all phenomena . An appropriate atmospheric pressure can guides the process response to achieve the anticipating need of any design. To be studied here is the Bernoulli equation, pressure in a fluid .

Fluid resistance: By setting up a pre- test to investigate the resistance of the fluid, under steady direct current, one can do some experiment with simple electric circuits and using a multimeter for testing resistances.

2.2.1.2 Fluid static

The fluid which no shearing stress existing and no relative motion is called fluid static. In the book edited by **Merle C. Potter and David C. Wiggert, 1997** : Chapter 2, it is shown that there are three situation as predicted in Figure 2.2 involving the fluid static.

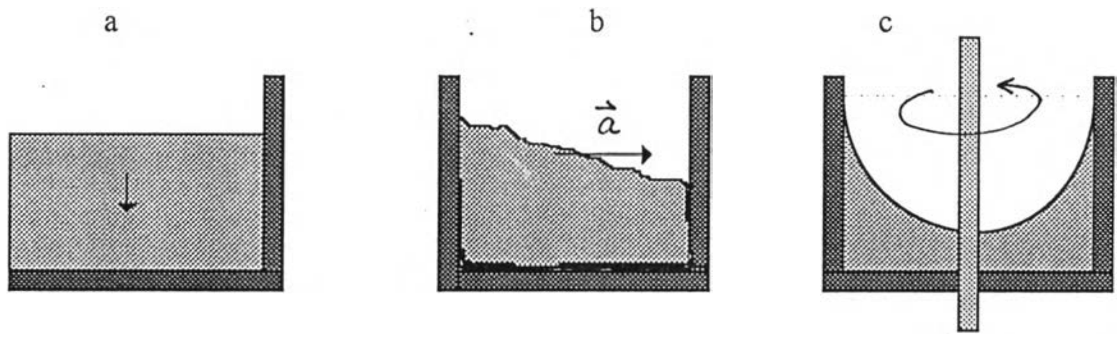


Figure 2.2 Three situation of fluid static

a) fluid at rest

b) linear acceleration

c) angular rotation

- *Fluid at rest :*

It means that there is no movement or on the other hand a very slow movement, such as water pushing against a dam, water or fluid in a container

- *Fluid at linear acceleration*

A fluid in container will be against a linear movement, such as a transportation of liquid substance along the road, This fluid is undergoing a linear acceleration of a

- *Fluid at angular rotation*

The fluid in container will be related in a cylinder, the rotational energy will cause the fluid surface in form of a parabolic shape.

- *Pressure in liquid at rest*

$$\mathbf{P+\gamma z \;=\; constant}$$

where, P= pressure, $\gamma = \rho g$, z = depth

so that the pressure increase with depth.

- *Force on plane areas*

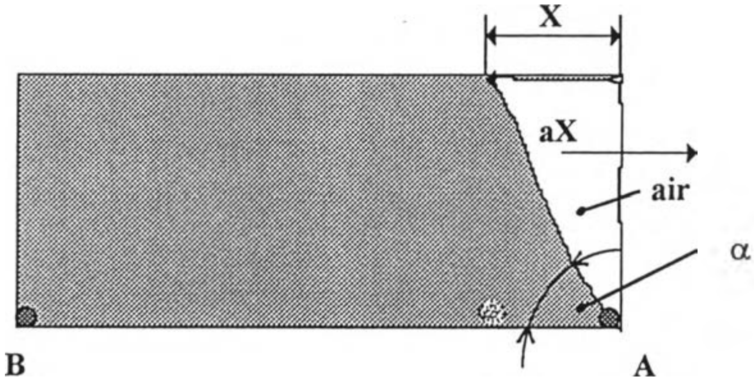


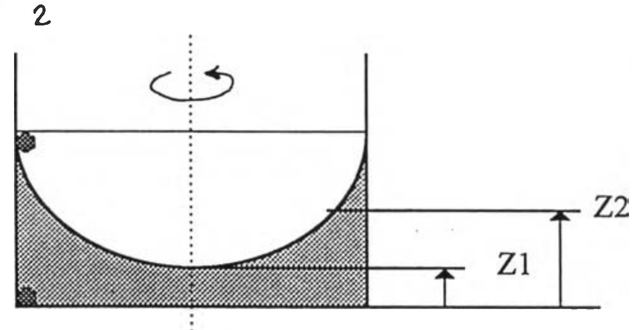
Figure 2.3 Liquid in a moving container

$$\mathbf{pA - pB = -\;\rho a^*(X_B - X_A)}$$

- *Rotating container*

$$\mathbf{F \;=\; \tfrac{1}{2}\;(pA+pB)^*\;area}$$

$$\frac{\omega^2 r^2}{2} = g\,(Z2 - Z1)$$



a)

b)

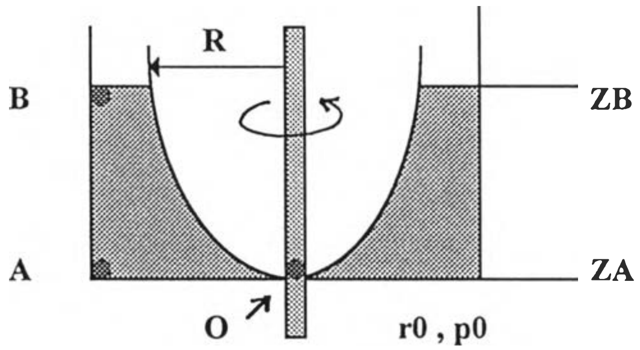


Figure 2.4 Rotating container a)Z = Z1, b) Z = 0

- *To find the pressure at A*

r2 = rA, r1 = r0 , p1 = p0 =0 :

$$\mathbf{pA = \tfrac{1}{2}\,\rho\omega^2(rA^2 - r0^2)}$$

- *To find the pressure at B*

$$\mathbf{pB - pA = -\rho g\,(zB - zA)}$$

$$\omega \quad = \mathbf{2 \cdot \pi \ rad/s}$$

$$\alpha \quad = \mathbf{r\,\omega^2 \ \ m/s^2}$$

- *Reynold number*

Reynolds studied the conditions under which one type of flow changed into the other and found that the critical velocity at which laminar flow changes into turbulent flow. **(Warren L. Mc Cabe: Julian C. Smith: Peter Harriott, 1993)** This phenomena depends on four quantities namely;

1) The nozzle diameter
2) The viscosity of fluid
3) The density of the fluid
4) The average linear velocity

He found that these four factors can be combined as follows:

$$N_{Re} = \frac{D\bar{V}\rho}{\mu}$$

where , D = diameter of tube = nozzle

$\bar{V}$ = average velocity of liquid

μ = Viscosity of liquid

ρ = density of liquid

- *Continuity equations;*

$$A_1\bar{V}_1 = A_2\bar{V}_2$$

- *mass rate of flow*

$$\dot{m} = \rho A\bar{V}$$

- *Volume rate of flow*

$$Q = A\bar{V} \qquad m^3/s$$

The flow is always lamina at the **Reynolds numbers less than 2100**

2.2.2 Applied Statistical Method

- **Design of Experiment** is a powerful statistical method of investigation which factor ,which input variable affecting on the anticipating output response (**D.C. Montgomery, 1983**) The factor in production system is divided into two main groups:

controllable factor : The factors which can be fixed or defined are grouped as controllable factors.

Uncontrollable factor : The factor which can be not defined or not evaluated in a production . Such as the behind-the-time technology , a high cost production, are the uncontrolable factors.

The design of experiment for analysis the effect of the factors to the output production has to be varied at least two level . For example , suppose Y is the diameter of Foi-tong and μ is the viscosity of egg emulsion

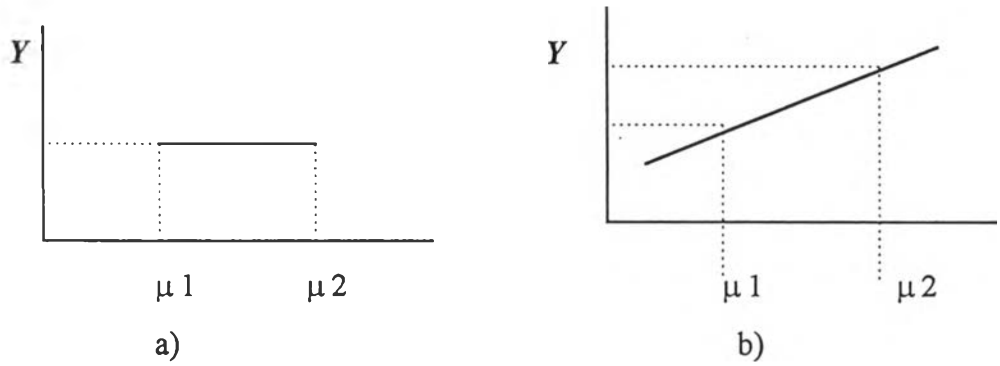


Figure 2.5 Factor with no effect and effect to the product.

a) Factor μ has no effect to diameter of Foi-tong.

b) Factor μ has effect to diameter

- **Objective**

1. To confirm the phenomena or behavior of the factors. It is an improvement against the belief .

2. To explore the influence of the new conditions which can affect the process.

- **Analysis of the 3^k factorial design**

Notation for the 3^k series

The 3^k factorial arrangement is a factorial with k factors and at each three level. Factors and interactions will be denoted by capital letters.

- **The 3^3 Design for the case of Foi-tong production**

There three factors under the study and each factor is at three levels arranged in a factorial experiment. The notation of experimental layout and treatment are shown in Figure 2.6 below. The amount of treatment is 3^3 = 3x3x3 = 27 treatment combination and 26 degree of freedom (**D.C. Montgomery, 1984)** .

But some case ,it can be modified this model :such as 5x3x3 and 3 replications .This model is called general factorial

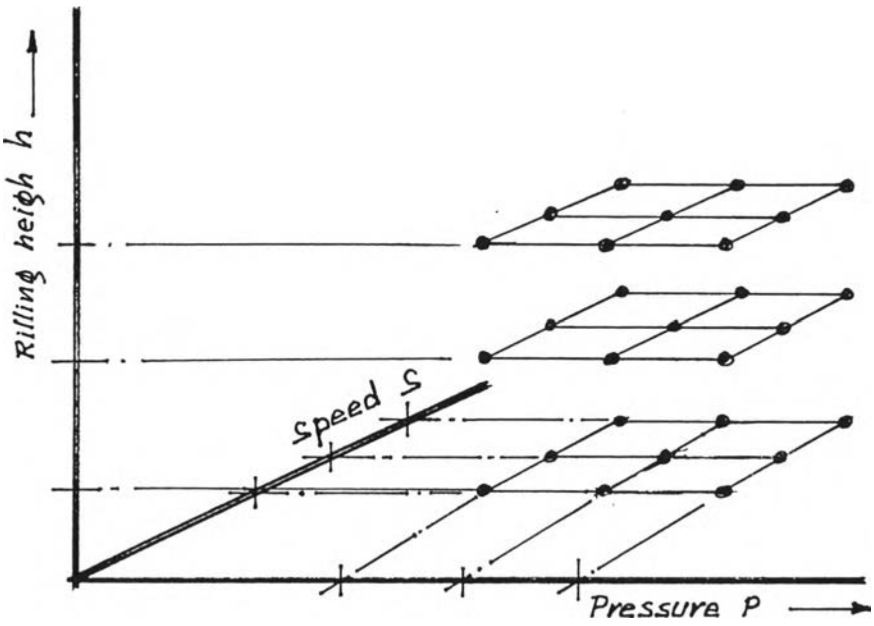


Figure 2.6 Treatment combination in 3^3 design factor p = pressure, factor s = speed, factor h = height Factor p has 2 degrees of freedom Factor s has 2 degrees of freedom .and Factor h has 2 degrees of freedom

- **Interaction between 2 factors**

Factor p and factor s has 4 degree of freedom , Factor s and factor h has 4 degree of freedom , Factor p and factor h has 4 degree of freedom

- **Interaction between 3 factors**

Factor **p+ s + h** has 8 degree of freedom.

- **One way ANOVA**

Some case is lacking of some data or on the other hand the collected data are missing due to the experiment could be not continued , the application of ONE WAY Analysis of Variance is appropriated.

2.2.3. Conceptual and embodiment design

Conceptual design is the most creative and constructive phase of the design process **(Mike Greenwood , WMG -Module , 1997)** There are several concept alternatives to design a circular motion and linear motion equipment. By application of a compression could be one of those alternatives. The concept design start with a sketch as a model and developed into a general assembly drawing of the test tube . Practically, after selection of an alternative of conceptual design , the embodiment design was developed . It is composed of design brief requirement . The potential problems are identified and the creative process are applied in their resolution . Cost estimation for the major assemblies of the product are defined.

Detail drawing: The detail design supports the manufacturing process of the product component.

Design for Assembly: According to **Greenwood, M. (1997.)** the assembly ability of alternative design is taken in account .Significant benefits are being experienced not only in the production cost but also in improvement of the product in term of quality, reliability, flexibility and so on..

2.2.4 Automation concept

A machine design with fixed automation is being discussed . The sequence of the control of the system is fixed by the configuration of the equipment. It means that can it is not easy to be modified the control system. For the simple control system is in this thesis selected are pneumatic, electric control system.

2.2.5. AutoCad Application

The application of AutoCad is very necessary for today design. AutoCad Release 13 on Window 95 is obtainable and very powerful.

2.2.6. Machine design and machine elements

(Matek , W. and Roloff, H. , 1976)

All machine elements such as belt transmission, gear transmission, bending in small beam, motor selection joining elements and their relevant calculations can be sourced out. The application criteria and standard part are also available in this source. Involving all design elements such as welding joints, riveted joints, design of shafts flywheels, packing and seal, keys, pins, cotters, and joints. Thread and fasteners, screws for power transmission, springs and its calculation and selection criteria .

(Lingaiah.K., 1994)

2.2.7. <u>Standart parts</u>

(Sornnil, B.;and Gueysomboon, P., 1981)

The standard table for elements for machine design can be selected. Almost all parts are German standardized according to the DIN (Deutsche Industrie Norm)

2.2.8. <u>Premitive Foi-tong machine</u>

(Chueakittisak , S., 1991)

Chueakittisak, S. had designed and set-up a small Foi-Tong apparatus using the rilling system with 5 offset holes underneath the rilling cup. He observed that the rilling effectiveness through the 5 through holes was satisfied but the string configuration of foi-tong still not good as expected. The emulsion dropping in the pan was one of the problem . He designed a clipping lids for closing the rilling holes. It was still manually operated and inconvenient. After stopping the rilling cup, the egg emulsion still dropped and sometimes the egg drops would be well-done at the outlet of the holes .That caused the obstacle in the rilling holes. Besides this, during the picking-up of the well-done noodle out from the pan, he found that there was an collision occurrence between the picker and the rilling cup. Production capacity was still below the need. This machine was installed in Home Economic Division of Samutprakarn Technical College as an educational apparatus.