CHAPTER II

THEORETICAL BACKGROUND AND LITERATURE REVIEW

2.1 Theoretical Background

2.1.1 Inkjet Printing System [2]

Inkjet printing can be defined as a fluid control device with specific fluid control parameters. Microscopic ink drops are emitted under pressure from an orifice onto a substrate. The size of an orifice can vary from 10 to about 100 μm depending on the technology used. The color of the output also varies according to the type of printer used. Some printers output in monochrome; some have a three-color output, using the primary subtractive colors magenta, yellow, and cyan; and some printers use the four-color technology, which includes inks in the primary subtractive colors plus a black ink.

Two basic forms of inkjet printers comprise the majority of inkjet. The first is the continuous flow inkjet technology, and the second is the drop-on-demand or impulse inkjet technology. Both these forms can be further divided into other categories according to the mechanism by which the drops are projected from the orifice onto the printing medium or to the novelty of the ink in its application to the inkjet technology.

a) Continuous flow inkjet

The continuous flow technology is based on the principle of continuous emission of ink from a high-pressure source (~550 psi) through a capillary of between 10 and 15 μm. Drops are generated at a frequency of 40-45 kHz.

A binary-deflection system, the ink stream undergos a charge/no charge condition by binary switching. In certain Hertz technology inkjet printers, individual drops, which are formed when the main stream of ink separates, pass through a high voltage field . Uncharged drops pass through the high voltage field and are deposited onto the substrate to form part of an image. Unwanted drops have a charge applied to them. When these charged drops pass through the high voltage, they are repelled by the electrode and are deflected into a gutter. This system is shown in Figure 2.1

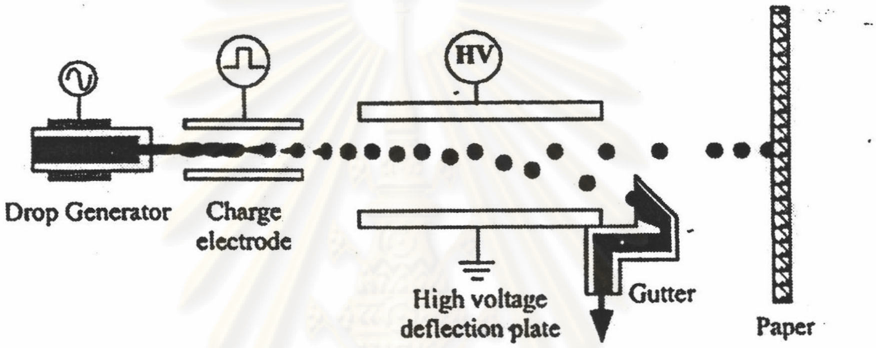

Figure 2.1 Continuous inkjet: A binary-deflection system

Figure 2.2 shows a multiple deflection system, drop are charged and deflected to the media at different levels.

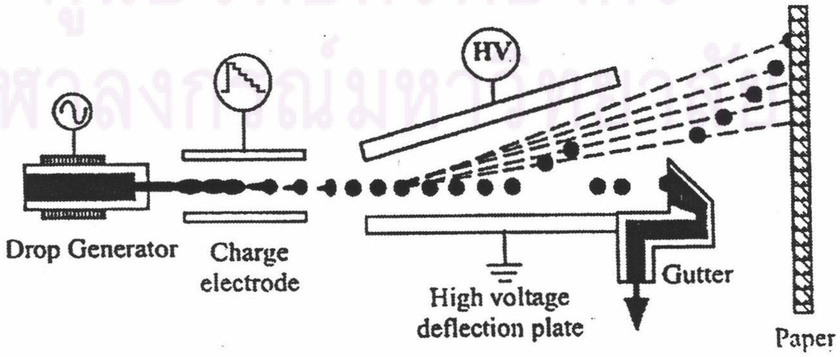

Figure 2.2 Continuous inkjet: A multiple-deflection system

b) Drop-on-demand inkjet [3]

The basic concept of drop-on-demand or impulse inkjet printing is to eject a drop of ink from a nozzle onto a substrate. The drop is emitted by means of a binary pulse acting on a mechanism, which delivers the energy to produce such a drop. The ink is contained in a chamber. The forces of hydrostatic pressure cause the ink to form concave meniscus. The nozzle may vary from about 40 micrometer to about 100 micrometer. An electrical driving pulse acts on the chamber, causing the volume of ink to decrease, thus emitting a drop of ink from the orifice at a relatively high velocity. The frequency at which the drops are ejected varies greatly depending on the manufacturer of the system. The operating frequencies in general vary in the range of 2-8 kHz. The velocity of the drops usually ranges between 1 and 3 m/s. Depending on the mechanism used in the drop formation process, the technology can be categorized into four major methods: thermal, piezoelectric, electrostatic, and acoustic inkjet. On the market today are using either the thermal or piezoelectric principle. Both the electrostatic inkjet and acoustic inkjet methods are still in the development stage with many patents pending and few commercial products available.

A thermal inkjet consists of an ink chamber having a heater with a nozzle nearby. With a current pulse of less than a few microseconds through the heater, heat is transferred from the surface of the heater to the ink. The ink becomes superheated to the critical temperature for bubble nucleation, for water based ink, this temperature is around 300 °C. When the nucleation occurs, a water vapor bubble instantaneously expand to force the ink out of the nozzle. Once all the heat stored in the ink is used, the bubble begins to collapse on the surface of the heater. Concurrently with the bubble collapse, the ink droplet breaks off and excels toward the paper. The whole process of bubble formation and collapse takes place in less than 10 micrometer. The ink then refills back into the chamber and the process is ready to begin again.

Depending on the channel geometry and ink's physical properties, the ink refill time can be from 80 to 200 microsecond. This process is illustrated in Figure 2.3 shows the drop formation of thermal inkjet process.

In the piezoelectric inkjet, depending on the piezoceramic deformation mode. The technology can be classified into four main types: squeeze, bend, push, and shear. A squeeze-mode inkjet can be designed with a thin tube of piezoceramic surrounding a glass nozzle or with a piezoceramic tube cast in plastic that encloses the ink channel.In a typical bend-mode design, the piezoceramic plates are bonded to the diaphragm forming an array of bilaminar electromechanical transducers used to eject the ink droplets. A bend-mode piezoelectric inkjet which be showed as Figure 2.4.

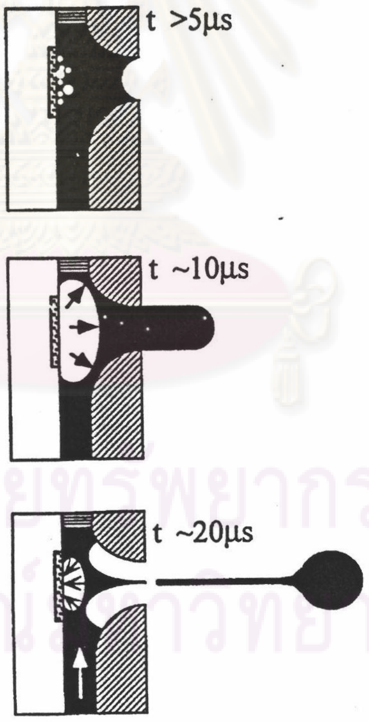

Figure 2.3 Drop formation process of a thermal inkjet.

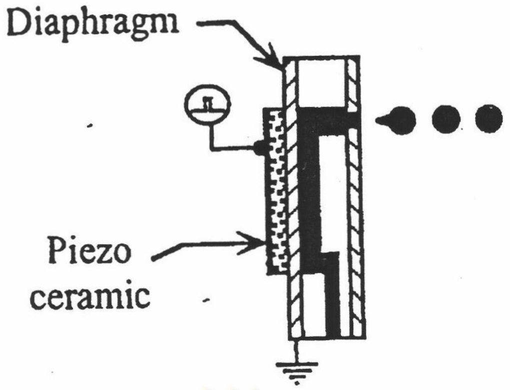

Figure 2.4 A bend-mode piezoelectric inkjet design.

In a push-mode design as the piezoceramic rods expand, they push against ink to eject the droplets. In theory, piezodrivers can directly contact and push against the ink. However, in practical implementation, a thin diaphragm between piezodrivers and ink is incorporated to prevent the undesirable interactions between ink and piezodriver materials. Figure 2.5 shows a push-mode piezoelectric inkjet.

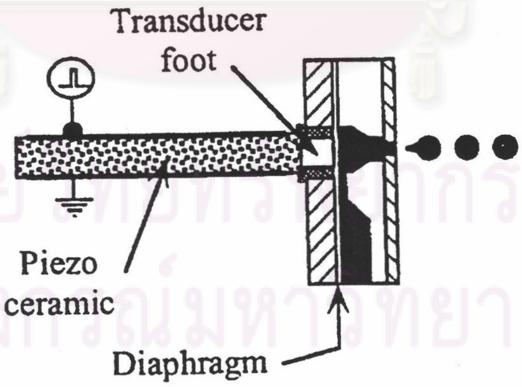

Figure 2.5 A push-mode piezoelectric inkjet design.

In both the bend- and push-mode designs, the electric field generated between the electrodes is in parallel with the polarization of the piezomaterial. In a shear-mode printhead, the electric field is designed to be perpendicular to the polarization of the piezodriver. The shear action deforms the piezoplates against ink to eject the droplets. In this case, the piezodriver becomes an active wall in ink chamber. Interaction between ink and piezomaterial is one of the key parameters of a shear-mode printhead design. Figure 2.6 shows a shear-mode piezoelectric inkjet.

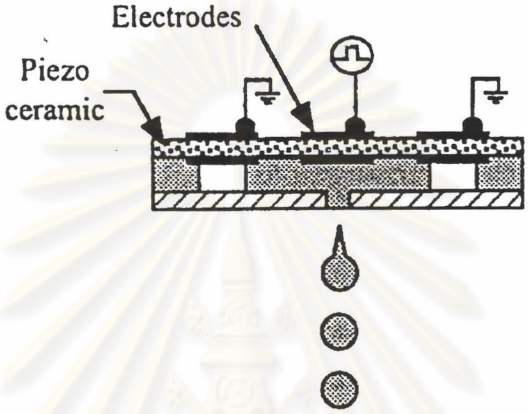

Figure 2.6 A shear-mode piezoelectric inkjet design

The deformation of the piezoceramic material causes the ink volume change in the pressure chamber to generate a pressure wave that propagates toward the nozzle. This acoustic pressure wave overcomes the viscous pressure loss in a small nozzle and the surface tension force from ink meniscus so that an ink drop can begin to form at the nozzle. When the drop is formed, the pressure must be sufficient to expel the droplet toward a recording media. The basic pressure requirement is showed in Figure 2.7.

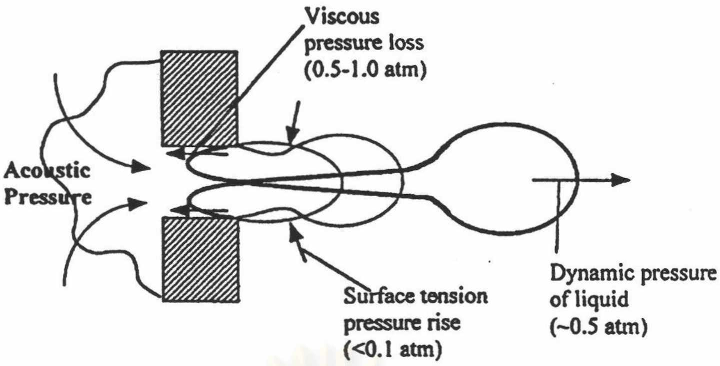

Figure 2.7 The basic pressure requirement for ejecting an ink droplet

2.1.2 **Properties of Inkjet Inks [4,5]**

2.1.2.1 Viscosity

The viscosity of the ink is of primary importance. A humectant such as glycol is the primary constituent that affects this parameter. In inkjet systems, the amount of humectant will affect the degree of crusting caused by dye precipitation. Too much humectant would greatly hinder the flow of ink through a 10 μm nozzle. The drop-on-demand printers require a more viscous than the continuous inkjet printers. This is because, instead of high pressure, the drop-on-demand system uses an acoustic wave, usually produced by a piezoelectric transducer, to emit and propel an ink drop. Acceptable viscosities are no greater than 20 mPa s, and preferably in the range of about 1.0 to about 10.0, preferably 1.0 to 5.0 mPa s at room temperature.

Another aspect of viscosity is the need to have the ink behave as close to a Newtonian fluid as possible. The ideal system maintains a constant viscosity regardless of shear rate. In other words, the best system doesn't become more or less fluid as it is drawn from the reservoir, shot through the nozzle, or contacts the substrate.

2.1.2.2 Specific gravity

The specific gravity of the fluid is needed to determine the weight of the mass to be propelled for velocity studies, and to determine other physical properties.

2.1.2.3 Surface tension

Surface tension is one of the primary factors determining where the actual drop will form in continuous inkjet printers. In drop-on-demand printers, it helps to regulate control of the concave meniscus to hold ink in the system. Once the ink has been deposited onto the printing substrate, the interaction of the surface dynamics of both ink and paper play a major role in how the final form of the dot will appear.

Surface tension of the ink is a measure of the energy with which the liquid molecules cling to each other. To have optimum drop formation, the high surface tension gives the spherical drop. Of the practical ink solvents, water provides the highest surface tension on the order of 72 mN m^{-1}. When used in an actual formulation, this value is reduced to 40-60 mN m^{-1} by the other ink components, including colorants, polymers, and additives. Solvent-based inks have surface tensions closer to 20-30 mN m^{-1}. While high surface tension is helpful for drop formation, it is undesirable for wetting or non-porous surfaces such as plastic films, metal cans, and foils. These are low surface energy substrates, and high surface tension liquids tend to form beads, rather than wet them. It is not usual to corona treat plastic films to improve wetting, adhesion, and drying of water-based inks, including inkjet inks.

A surface tension in the range of about 20 mN m^{-1} to about 70 mN m^{-1} and, more preferably, in the range 30 mN m^{-1} to about 50 mN m^{-1}. Control of surface tensions in aqueous inks is accomplished by additions of small amounts of surfactants.

2.1.2.4 Conductivity

The continuous inkjet system imposes an electrical charge on the drops, ink conductivity is important for that process. Conductivity for drop-on-demand systems is not an issue. The units of conductivity are $\mu S\ cm^{-1}$ (microsiemens per centimeter) and the range of operation is usually 1,000-10,000. This is controlled by incorporation of soluble salts in the ink, making certain they are non-corrosive. In many instances, the dye, or salts brought into the formulation with the dye, will provide conductivity as well.

2.1.2.5 pH

The pH of the ink is critical for several reasons. First of all, the solubility of the dye is greatly affected by pH. The hue of some dyes will change if they go from a low to high pH value. There must be a correlation between the pH values of the ink and of the printing media; otherwise, the archival quality of the print may deteriorate. Another reason for controlling pH of the ink is that the orifice of some inkjet systems may be made of material that is affected by pH. If this is the case, the pH of the ink should be close to neutral to prevent any corrosion. Pigmented inkjet inks suitable for use with inkjet printing systems should have, a pH in the range of 5 to 9

2.1.2.6 Maximum particle size

All inkjet inks must pass through an orifice, no particle larger than that opening can be tolerated in the ink, The results of ink jet nozzle clogging are obvious. To control maximum particle size in the ink by filtration both during the manufacturing and in the mechanical printing equipment. A maximum particle size of 1 μm., is generally acceptable in the ink.

2.1.3 **Composition of Water-Based Inkjet Inks [3]**

Ink formulations not only dictate the quality of the printed image, but they also determine the drop ejection characteristics and the reliability of the printing system. Many different types of inks have been developed and used in inkjet applications. Aqueous- or water-based inks are commonly used in home and small-office inkjet. Typical composition of a water-based ink for inkjet print is presented in Table 2.1.

Table 2.1 Water-based inkjet ink composition

Component	Function	Concentration
Deionized water	Aqueous carrier medium	60-90
Water soluble solvent	Humectant, viscosity control	5-30
Dye or pigment	Provides color	1-10
Surfactant	Wetting, penetrating	0.1-10
Biocide	Prevents biological growth	0.05-1
Buffer	Controls the pH of ink	0.1-0.5
Other additives	Chelating agent, defoamer etc.	> 1

2.1.4 Composition of Aqueous Pigmented Inkjet Inks [6,7]

2.1.4.1 Pigment

A wide variety of organic and inorganic pigments, alone or in combination, may be selected to make the ink. The pigment particles are sufficiently small to permit free flow of the ink through the inkjet printing device, especially at the ejecting nozzles that usually have a diameter ranging from 10 μm to 50 μm The particle size also has an influence on the pigment dispersion stability, which is critical throughout the life of the ink. Brownian motion of minute particles will help prevent the particles from flocculation. It is also desirable to use small particles for maximum color strength and gloss. The range of useful particle size is approximately 0.005 μm to 15 μm. Preferably, the pigment particle size should range from 0.005 to 5 μm and, most preferably, from 0.005 μm to 10 μm.

2.1.4.2 Dispersant

Dispersants are materials that can bind to the pigment with one part of a molecule, while the other is attracted to the vehicle. A dispersant typically coats the pigment particles and then attracts a coating of the vehicle, which allows the coated particles to disperse in the vehicle. Clumping and agglomeration of the pigment particles are therefore minimized due to a steric or electro-steric repulsion caused by the protective coverage.

2.1.4.3 Water

The majority of inks used in inkjet printers are water-based inks. Exceptions are the inks used in the hot melt or phase change inkjet systems or solvent inks, which are primarily used in commercial inkjet applications. In water-based inks, the liquid portion of the ink, which is referred to as the vehicle, is mostly comprised of water. Water to be used in the makeup of an ink should be as chemically pure as possible. It should be free of calcium, chlorides, sulfates, and heavy metals or contain only minimum trace amounts. The water should be distilled or deionized.

2.1.4.4 Humectants

Humectants are added to inks for two purposes: first to retard the evaporation of the ink in the printhead, and second to act as a dye solubilizer. Some typical hurnectants, used either alone or in combination with one another, are diethylene glycol, glycerol, and polyethylene glycol. These chemicals belong to a family called polyhydric alcohols. If the ink undergoes evaporation, several conditions may occur. The viscosity of the fluid may be increased, thus altering the parameters of the ink.

The proper choice of the grade and quantity of the humectant to be used in the formulation is one of the biggest challenges facing the ink chemist. If the quantity is too high, the ink may take too much time to dry on the printed substrate, even on heavily coated papers. If the quantity is decreased, the ink delivery system may fail as a result of orifice clogging. There is a fine line in determining the percentage of humectant to add to the ink formulation that will allow maximization the ink system so that neither type of failure will occur.

2.1.4.5 Bactericides and fungicides

Organic compounds in the ink are perfect media for the growth of both bacteria and fungi. Once a colony of either organism has become established, it is a possible source of orifice clogging. To prevent this condition, a bactericide and/or a fungicide must be added to the ink formulation.

2.1.4.6 Surfactants

The choice of surfactant is highly dependent on the type of substrate to be printed. The printing speed of inkjet printers is currently limited by the relatively slow rate at which ink penetrates the substrate. The addition of surfactants to inkjet inks permits the ink to wet rapidly into a variety of substrates without introducing potentially toxic and destabilizing additives. The drying time is reduced from about 70 seconds required for non-surfactant containing inks to as little as 5 seconds for inks containing surfactants. Moreover, the addition of surfactants permits the preparation of inks suitable for high speed printing without the necessity for the addition of relatively large quantities of solvent which may injure the ink stability, materials of construction of the ink cartridge, or possibly introduce toxicity or flammability.

The surfactant selected for the ink composition needs to be compatible with the other components, particularly the polymer and surfactant have to be of the same type, i.e., anionic or cationic. Non-ionic surfactants can be used with either type of polymer. A concentration of surfactant of from about 0.1% to about 10% of the total ink composition is effective with about 0.5% to about 3% being preferred.

2.1.5 Inkjet Inks for Fabric Printing [8, 9]

There are some strict constrains on the physical properties of inks that can be ejected from an inkjet print head. Viscosity of inkjet ink must be quite low compared to rotary screen printing pastes. High surface tension of the ink formulation and the need to use very high purity components are further limitations.

Colorants used for inkjet printing on paper have typically been selected based on high water solubility and high chroma and with little regard for substantively. Acid and direct dyes have been frequently used for printing on paper. These dye classes would not normally be used for printing on cellulose fiber fabrics. Thus, most of the formulations used for inkjet printing on paper are not acceptable for textile printing.

For pigment printing on textile, there are not any reactive groups on the pigment, which interact with the fiber of textile. Any pigments applied to textile fibers will require the additional use of polymeric materials, known as binders, to encapsulate the particles deposited on the fiber surfaces and hold them on the surface by virtue of the adhesion between the fiber and the binder. This adhesion has no reaction with the pigment but depends on the characteristics of the binder. Without the binder, the particles deposited on the fiber surfaces will wash off, crock and abrade from the fibers without difficulty and will reveal the unpigmented base color of the fibers beneath. The pigment particles will have been too large to penetrate into the fibers. Binder films should be chemically and physically inert with respect to acids, alkalis, chlorine bleaches, ozone, UV and visible light and, under hot pressing conditions, should neither discolor nor be thermoplastic.

2.1.6 Film-Formation of Polymer Emulsion [10]

The film-formation of polymer emulsions can be described in a model by a step-by-step transition between four different stages, which shown as Figure 2.8 The initial stage is a disperse system of polymer particles (stage). By evaporating the water a dense packing is formed. The particles contact each other, the intermediate spaces of this packing are filled out with water (Stage II). During the evaporation of this residual water above the minimum film forming temperature, a deformation of the particles takes place and due to the effect of capillary and surface forces a pore-free film is formed (Stage III). In this stage of film formation the individual particles retain still their identity. After further coalescing and interdiffusion of the polymer chains beyond the original particle borders a homogeneous polymer film will form (Stage IV).

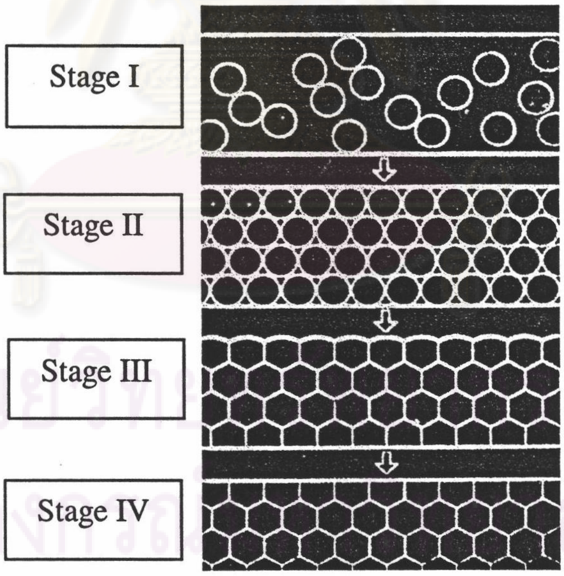

Figure 2.8 Model of the film formation of polymer dispersions

2.1.7 Physical Properties of Textile Fibers [11, 12]

2.1.7.1 Cotton fiber

Cotton fibers compose of cellulose molecules, which consist of a series of glucose rings joined together, with the formula;

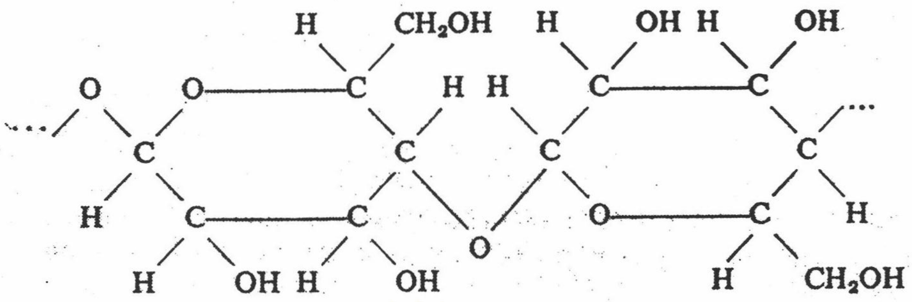

Figure 2.9 Glucose ring of cellulose molecule

It is a long-chain molecule, made up of groups that are linked together by valency bonds. The strength of these bonds is such that, if the whole strength of the chain could be utilized, it would have a strength more than ten times as great as that of the strongest cellulose fiber. It is a ribbon-like structure, which can bend and twist to some extent, particularly at the oxygen bridges between the rings of atom, so that it is flexible. Protruding from the chain are hydroxyl (-OH) groups, which can link up with other hydroxyl groups by means of hydrogen bonds. This results in the linking together of neighbouring chains as shown in Figure 2.10. Water molecules can also be attached by the same sort of bond

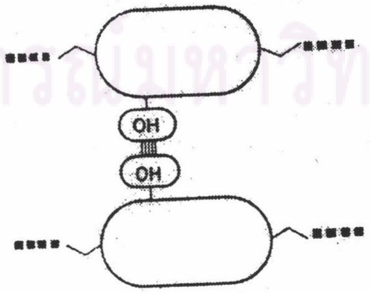

Figure 2.10 Cross-linking of cellulose molecules by hydrogen bonds

In the crystalline regions, the molecules would be arranged in regular order linked together by hydrogen bonds. The non-crystalline regions (about one-third of the total in native celluloses) are often referred to as amorphous or disordered regions. There is, however, no evidence that the arrangement of the molecules is completely irregular, and there will be some degree of order in the non-crystalline regions.

2.1.7.2 Silk fiber

Silk fiber is a protein fiber, which are formed by the polymerization of amino acids with the general formula $NH_2CHRCOOH$, by means of peptide links (-CO-NH-) to give long-chain molecules with the general formula:

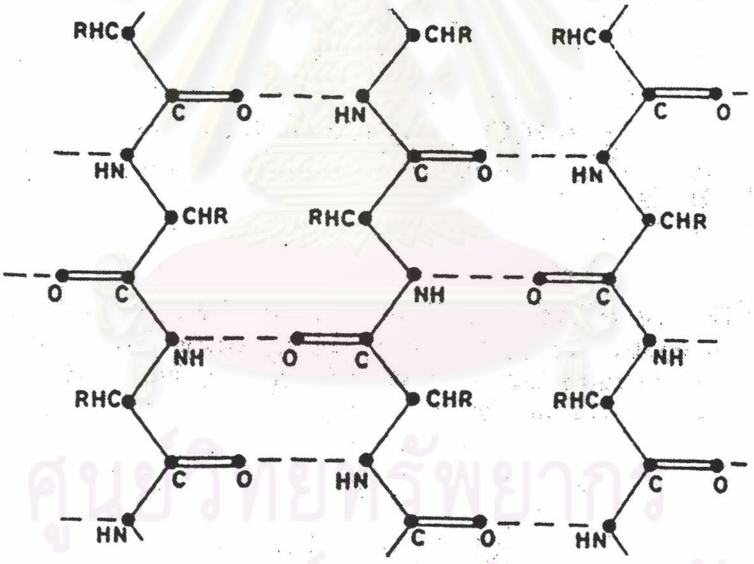

Figure 2.11 Extended-chain molecules of silk fibroin

In natural proteins, about twenty different side groups (R_1, R_2, etc.) are found. It is the variation in the order and amount of these groups that determines the properties of the material and gives rise to the large number of natural proteins that play a vital part in animal and plant life. In effect, there is an alphabet of side groups.

A complete analysis of insulin and some other proteins has been achieved, but for most proteins the order of the groups is still unsolved.

There are various sorts of cross-links that can form between neighbouring protein molecule

(a) Hydrogen bonds can form between the –NH- and –CO- groups, linking neighbouring main chains together;

(b) Hydrogen bonds may form between hydroxyl groups present in the side chain

(c) Since there are both acidic and basic side chains, salts may form between them, holding the side chains together by electrovalent forces.

(d) The cystine linkage, deriving from a double amino acid, will form a covalent crosslink between adjacent chains.

The main constituent of silk is one of the simpler proteins, fibroin. Almost all the side groups are of four simple types:

$$-H, \quad -CH_3, \quad -CH_2OH, \quad -CH_2C_6H_4OH$$

The links between molecules will therefore be mostly main-chain hydrogen bond, with a few hydrogen bonds and salt linkages between side chains.

Silk is essentially used in very expensive luxury goods. It has been able to withstand competition from synthetic fibers in many high-quality textile applications because of its excellent dyeing characteristics, high moisture and absorbency, and heat-preserving property. It has one major drawback that it does not blend easily with other fibers.

2.1.7.3 Polyester fiber

Polyester fiber is a synthetic fiber, which is linear polymer and there may be small proportions of other groups inserted within chains, at chain ends, or as a chain branches in order to modify such fiber properties. Polyester fibers are made by melt-spinning and drawing, from linear-condensation polymers, composed at least 85% by weight of an ester of a substituted aromatic carboxylic acid, including but not restricted to substituted terephthalate units and parasubstited hydroxybenzoate units.

Polyester fibers have a smooth surface and generally have a circular cross section, except for some special types produced in a trilobal form. Polyester is produced in a wide range of deniers and staple with bright, semidull, or dull luster. It has excellent tensile properties, good recovery from stretch, low moisture content and high abrasion resistance. It has a relatively high coefficient of friction and smooth surface. It is a thermoplastic fiber and melts when heated to high temperatures. In all practical senses, polyester fiber is an inert fiber, highly resistant to most of the common organic solvents. Polyester fibers are hydrophobic in character. They are therefore dyed by dyestuffs, such as disperse dyes, and so on, which are insoluble in water. Polyester fiber or fabric may be heat set to impart dimensional stability which may be affected by any subsequent heat treatments or produce bulk and stretch characteristics in woven or knitted fabrics.

Polyester fibers are used in many applications including carpets, upholstery, and industrial uses. A very large proportion are produced in staple form, which is used in blends with wool, cotton, viscose rayon, and linen. The inclusion of polyester fibers in blends improves the wear and abrasion resistance and the ease of care characteristics of fabrics. Other areas of polyester fiber use include fillings in pillows and quilts, sewing thread, tire yarns, conveyor belts, nad ropes and twines. In today's commercial markets, there are several modified forms of polyester fibers being produced, such as bicomponent fibers, fibers with multilobal cross section, and chemically modified forms.

2.1.7.4 Fiber blends

The fibers may be blended or combined in various yarn and fabric structures. The accepted definition of a blend as stated by ASTM is a single yarn spun from a blend or mixture of different fiber species. Blends may be composed of various percentages of the fibers involved. For example a blend of 65 percent polyester and 35 percent cotton utilizes yarns in which each single yarn strand has approximately two polyester fibers for each cotton fiber. Other blends would be assembled in a similar manner.

Engineered textile fabrics are the result of considerable research, development, and testing. In place of developing new fibers to produce special end-use properties, fibers currently manufactured are being combined in various ways to produce yarns and fabrics with specific qualities. A blend that is properly engineered provides the consumer with the most desirable properties of all fibers used.

Blends of wool, cotton, rayon, or flax (linen) with polyester fibers are popular with both men and women. Polyester fibers add easy maintenance, strength and durability, abrasion resistance, relatively wrinkle-free appearance, shape and size retention to blend fabrics, while protein or cellulosic fibers contribute dyeability, comfort, absorbency and reduce static charges.

In polyester blends various fiber manufactures have established desirable minimum amounts of polyester for use with different fibers. No less than 50 percent polyester and preferably 65 percent is recommended for use with all cellulosic fibers. No less than 50 percent polyester should be used with wool and no less than 50 percent with synthesized fibers such as acrylics or modacrylics. When blended with cotton and nylon, there should be 65 to 75 percent polyester and nylon combined.[13]

2.2 Literature Reviews

The traditional screen printing, which is analog printing, uses a master for printing by screen printers, whereas the digital printing can reproduce computer-generated designs and has ability to change design quickly. The design and colors can be changed by sending different electronic pulses to the printheads. The pigmented inkjet textile printing eliminates the wet post processing, thus it has the potential to make agile manufacturing. However, the inkjet inks must be of very low viscosity, thus there are bleeding and wicking properties when printing on textiles. The inkjet pigment textile printing has been developed for agile manufacturing and distributed printing in the near future. [1]

Both continuous and drop-on-demand inkjet printer are available for using in high-speed textile printing. The inkjet vehicle must maintain physical properties necessary for a droplet formation, which is stable in aqueous solution, low vapor pressure, having hygroscopic, viscosity less than 10 mPa s, surface tension greater than 40 mN m^{-1}, high solubility for dye, and low freezing point. [14] Particle sizes of pigments effect in pigmented inkjet inks. Reducing the average pigment particle size in the ink from 50 nm to less than 100 nm significantly improves image quality such as color gamut and the reduction does not adversely affect the lightfastness. [15]

There are three new coloration systems for inkjet printing of textiles. These systems are polymerizable ink systems, polymerizable dyes systems, and two phase ink systems. The polymerizable ink systems consists mixture of monomers and oligomers that can be post polymerized on the fabric and solve the problems by adding a reactive diluent and a chain transfer agent. The polymerizable dyes system consists of modification of existing reactive dyes, which incorporate reactive groups.

These modified dyes are capable of being delivered by inkjet and permanently fixed on the surface of fibers without requiring a post washing and drying step. Two phase ink systems consists of the emulsion polymer for binding dyes and pigments to the fiber surface. The small particle polymer lactices in water can be deposited on textile substrates and can be thermally cured on the fabric. These polymer particle sizes are under 1 micrometer. [16] The research about the pigmented latex system for continuous inkjet printing on textile has shown that the total solid content of latex and pigment in ink can be up to 25%. The higher glass transition temperature polymer gave the best crockfastness and high stiffness on printed fabrics and the different fibers show different properties due to various interactions between ink and substrates. Crockfastness of cotton and silk fabrics was better than that of the cotton/polyester blend fabric. [17] The inkjet resin-pigment printing of silk fabrics yielded good stiffness and crockfastness. And acrylate resin with T_g near -15°C would appear to be best for a good balance between stiffness and crockfastness for use in silk fabric printing. [18]

High viscosity liquids are not appropriate for printing with the inkjet process, because they do not flow well enough to be applied through the inkjet nozzle. Low viscosity inks which are deposited onto fabric by the inkjet process are prone to spreading, because fabric does not retain ink very well. In addition, fabric often has texture, and the texture can increase the spreading of the ink on the fabric. Various methods of textile coating and treatment have been attempted to address these difficulties. For example, compounds such as starch, cellulose, gum arabic, and poly (vinyl acetate) have been placed onto fabric before forming a pattern on the fabric with inkjet printing in order to reduce spreading or wicking of ink. There is a research of the fabric for inkjet printing, which had a boehmite porous layer on the fiber of the fabric and the fabric was softening treated. The binder for boehmite particles was poly(vinyl alcohol) of about 5-50 % by weight on the basic weight of boehmite. The softening treatment of pretreated fabric includes stretching treatment, and calendering treatment. The study shows that the color density was around 1.23, and the treated fabrics have good water resistance that there is no change in the printed color density after washing. [19]