CHOCOLATE gives people great pleasure when eaten. It also makes a suitable gift for many occasions. The fat content of chocolate varies from 28% to 35% depending on its intended use. Cocoa butter obtained from cocoa beans or specialty fats obtained from vegetable oils and fats are the usual sources of fats for chocolate manufacture.

Specialty fats include cocoa butter equivalent (CBE), cocoa butter substitute (CBS), general purpose coating fats and toffee fat. Palm oil and palm kernel oil are ideal raw materials for the production of specialty fats due to their excellent physico-chemical properties. They can be further modified to extend their range of utilisation. CBE are specialty fats which contain symmetrical unsaturated triacylglycerols similar to that of cocoa butter (Table 1).

CBE are often regarded as fully compatible to cocoa butter. Generally, CBE is formulated with palm mid fraction (PMF) blended with illipe and shea fats. CBS are classified as lauric- and non-lauric-based. Lauric CBS are derived from the two major lauric oils namely palm kernel oil and coconut oil. Palm kernel oil can be fractionated to give palm kernel stearin with similar physical properties to that of cocoa butter. The stearin, with or without hydrogenation, is an excellent CBS suitable for the manufacture of solid or hollow-moulded chocolate products. Non-lauric CBS are made from oils such as palm, soybean, cottonseed and peanut oils. They have to be hydrogenated in order to bring their consistency to appropriate levels. These products have excellent uses in compound coating for biscuits, enrobed products and chocolate-flavoured baking chips. In products where price consideration is important, this type of CBS is a good alternative.

**Advantages of Using Palm-Based Fats in Chocolate Products**

Do not require tempering

Chocolate based on CBS crystallises rapidly into stable there is no need for tempering. This saves processing time.β’ crystal form, thus form stable crystals and are less subject to bloom

Chocolate made with CBS has a good resistance to fat bloom, thus the product looks shiny and attractive.

Have rheological properties suitable for modern and highly flexible production lines

The same production plant for pure cocoa butter chocolate can be used.

Stable in hot climates

The melting properties of the fat are higher than those of cocoa butter due to the stearic-oleic-stearic (SOS) triglyceride content. It is more stable in hot climates than cocoa butter.

Consistent quality

CBS has a low iodine value (IV), indicating low levels of unsaturated fatty acids. Thus, palm-based CBS are stable against oxidative deterioration.

Reliable supply

Palm oil and palm kernel oil can be obtained at all times of the year. The oils especially from Malaysia, which are of high quality, are readily available to be processed for CBE and CBS production.

The fats are bland in flavour. They can be used for chocolate-flavoured end products, white compounds and pastels. The fats are also compatible to a certain degree with milk fat and other non-lauric oils.

**Manufacturing Process**
Economical

The price of these fats is highly competitive than that of cocoa butter.

Costs can be reduced by replacing part of the cocoa butter with CBE or by replacing the total amount of cocoa butter with CBS.

Plain chocolate contains sugar, cocoa mass, 10% cocoa butter and 5% CBE. Milk chocolate contains sugar, full cream milk powder, cocoa mass, 15% cocoa butter and 5% CBE. In chocolate pastel, the cocoa is omitted. The colour of chocolate pastel is basically white and colour can be added to make it more attractive.

Processing

The ingredients are pre-mixed. Melted fat is added and mixed until smooth. It is then refined, conched, tempered, moulded, cooked and demoulded. The chocolates are then stabilised to complete crystallisation.

1. Pre-mixing

Raw materials, i.e. cocoa liquor, sugar and milk powder, are mixed with an adjusted fat content (26 ±1%) before the mass is refined.

2. Refining
It is important to refine chocolate paste in order to obtain the required smoothness. The mass is ground until 80% of particle size distribution is between 20-30μ. A roll refiner is commonly used for this purpose.

3. Conching

This process is characterised by chemical and physical change in the product mix. Flavour develops during the process and water content is reduced to less than 1%. A homogenous product mass is produced in an efficient homogeniser and this is a crucial step. During conching, good temperature control is essential. Temperature for plain chocolate is 65 oC- 90oC and for milk chocolate 50oC-65oC. Time for conching depends on the composition of the mass but it is normally more than three hours and often longer for plain chocolate.

4. Tempering
Tempering of the chocolate mass based on CBS is carried out by heating the mass at 50 oC the quoted slip melting point of the fat. For CBE-based chocolate, it is necessary to form the right amount of stable crystal in the chocolate mass to enable moulding.

The mass is heated at 50 to 26.5 - 25.5 oC-60oC and cooling it to at least 2oC aboveoC-60oC and cooledoC-27.5oC for plain chocolate andoC-26.5oC for milk chocolate.

5. Moulding

Temperature of the mass is raised to 31 oC.

The chocolate is then cooled in a cooling cabinet set at 5 oC-33oC (plain chocolate) and 29oC- 31oC (milk chocolate) respectively before moulding. Temperature of the mouldshould be 2oC-5oC lower than the moulding temperature of the mass. The chocolate mass is filled into the mould, tapped and strapped of excess chocolate.oC-12oC.
6. Cooling and Demoulding

A suitable cooling cabinet with air circulation and sufficient cooling capacity should be used. Cooling temperature is usually between 5 to 45 minutes (normally 15-20 minutes). For easy demoulding, the shrinkage should be sufficient. Difficult demoulding may be caused by:

- mould not being sufficiently cleaned
- chocolate not being properly tempered
- temperature of the mould not being appropriate (0°C-12oC) and time should not exceed.

The finished products are stabilised at 18 crystallisation. Plain and Milk Chocolate Formulation Using CBE oC-20oC for at least 24 hours to complete.

Plain and Milk Chocolate Formulation Using CBE

Plain

\[
\begin{align*}
\text{PLAIN} & : & 40\% \text{ cocoa mass} & & 10\% \text{ CR} & & 5\% \text{ CBE} & & 45\% \text{ sugar} \\
\text{MILK} & : & 10\% \text{ cocoa mass} & & 25\% \text{ milk powder} & & 5\% \text{ CBE} & & 45\% \text{ sugar}
\end{align*}
\]

Plain and Milk Chocolate Formulation Using CBS

Plain

\[
\begin{align*}
\text{PLAIN} & : & 20\% \text{ cocoa powder} & & 34\% \text{ CBS} & & 45\% \text{ sugar} \\
\text{MILK} & : & 10\% \text{ cocoa powder} & & 60\% \text{ CBS} & & 40\% \text{ sugar}
\end{align*}
\]

Triacylglycerol Composition of CBE and Cocoa Butter

<table>
<thead>
<tr>
<th>Fat</th>
<th>POP</th>
<th>POS</th>
<th>SOS</th>
</tr>
</thead>
<tbody>
<tr>
<td>CBE</td>
<td>15</td>
<td>30</td>
<td>25</td>
</tr>
<tr>
<td>Cocoa butter (Malaysia)</td>
<td>15</td>
<td>30</td>
<td>25</td>
</tr>
</tbody>
</table>

P - palmitic acid, O - oleic acid, S - stearic acid

Chocolate Process Flow Chart

RAW MATERIALS
PRE-MIXING
Mix chocolate liquor, sugar and milk powder and adjust fat content to 26%.

REFINING
Grind and smoothen chocolate mass to 20-30µ size.

CONCHING
- Mixture is homogenized
- Water content reduced to <1%
- Mix is conched for 3-3.5 hours at controlled temperature
  - Plus chocolate 65-80°C
  - Milk chocolate 50-65°C

TEMPERING
- Cool chocolate mass to 25-27°C above melting point of the fat.
- Tempering is not required if it can be moulded immediately.

CBE:
- Cool chocolate mass
  i. Plain Chocolate → 26°C-27°C
  ii. Milk Chocolate → 25°C-26°C
- Raise temperature of chocolate mass before moulding:
  i. Plain chocolate → 31°C-32°C
  ii. Milk Chocolate → 29°C-31°C

Moulding
- Mold temperature is 2-5°C lower than moulding temperature of chocolate mass

COOLING
Cool at 5°C-10°C for 15-20 min

STABILISATION
18-20°C for 24 hours to complete crystallisation.