LECTURE 5

5.1 METAL CANS

More than 49 billion metal cans are manufactured in the U.S. annually. This accounts formore than 30% of all units of consumer packaging.

The tin container was invented in 1810 by Peter Durand an English man.

It was introduced to the U.S. in the 1820's. At that time cans generally were made by hand. They were made during the winter months for use along with the next harvest. An expert can maker would produce 5 or 6 cans/hour.

"Sanitary" can was developed about 1900. This paved the way for mechanization.

The Metal Box Company is the only producer in Nigeria. At the moment they are making mainly No Al-type Cans. The total quality of cans manufactured are probably very much below the 10 million mark.

5.2 TIN PLATE CANS

Consist of a steel base sheet with a tin coating.

(a) the steel base plate is usually about 0.01 thick

(b) the tin coating has thickness varying from 15×10^{-6} inches thick

(c) Can enamels (Laquers) are baked organic coatings which are applied to improve stability of can interior when susceptible to damage by food materials packed in it.

The tin plate is an ideal material for food containers. Tin is not completely inert to all food. But corrosion and product chances are small if the proper choice of material is made.

Among the many factors considered by can manufactures are:

1. Chemical composition and physical properties of base plate
2. Thickness of tin coating
3. Application of protective coating or enamels
4. Container construction
5. Relative corrosivity of the product to be canned.

A large number tests are conducted prior to adoption of material.

5.3 A BASE PLATE

This is low carbon steel.

Metalloid content particularly of phosphorus, silicon are critical. Other trace metals of importance are copper, nickel, molyhdenum. The amount of these elements affect the corrosion resistance of the base plate.

Four Basic types of metal are used and a 5th is used for beer can ends

Element	% Permitted				
	Type L	Type MS	Type MR	Type MC	Beer End Stock
Mn	0.25-0.60	0.25-0.60	0.25-0.60	0.25-0.60	0.25-0.70
Carbon	0.12 max	0.12 max	0.12 max	0.12 max	0.15 max
P	0.015 max	0.015 max	0.02 max	0.07-0.11	0.10-0.15
Sulfur	0.05 max	0.05 max	0.05 max	0.05 max	0.05 max
Silicon	0.01 max	0.01 max	0.01 max	0.01 max	0.01 max
Cu	0.06 max	0.10-0.20	0.20 max	0.02 max	0.20 max
Nickel	0.04 max	0.04 max	No limit	No limit	No limit
Chromium	0.06 max	0.06 max	No limit	No limit	No limit

Molybdenum	0.05 max	0.05 max	No limit	No limit	No limit
Arsenic	0.02 max	0.02 max	No limit	No limit	No limit

5.4 CLASSES OF FOOD PRODUCTS AND TYPES OF STEEL BASE REQUIRED

Class Food	Characteristics	Steel Base Rqd
Most strongly corrosive	Highly or moderately Acid Foods	Type L
Moderately corrosive	Acidified vegetables, midly acid food products	Type MR Type MC
Midly corrosive	Low acid foods	Type MR Type MC
Non corrosive	Mostly dry and non processed products	Type MR Type MC

TERM BASE BOX: You will come across this term repeatedly. Originally Tin plate was sold in only one size sheet 14" x 20", 112 sheets – 1 Base Box. Such a package contained 31, 360 in or 217.78 ft^2 of surface.

TIN COATING

This is applied by either hot dip or by electroplating. Today only about 6% of all tin cans are made by hot dip which produce non-uniform tin coating.

Electrolytic plating can be differentially applied so that the inside and outside surface have different thickness of tin coating.

Hot dip - (1.25 1b/Base box) of tin

Electrolytic - (0.52 1b/Base box) of tin

ENAMEL COATING

These are baked organic coating, normally applied by roller to the flat sheet and are baked at temperatures below the melting point of tin.

Their purpose

(1) Preserve attractiveness of food in CAN

(2) Improve interior (occasionally only) exterior of can

(3) Increase shelf life of can

(4) Coating may make it possible to use less expansive tin coating

5.5 GENERAL TYPES OF ENAMEL COATING

Coating	Typical Uses	Type
1. Fruit Enamel	Fruits requiring protection from metallic salts e.g cherries	Oleoresinous
2. C-Enamel	Corn, peas and other sulfur-bearing products, including some sea foods	Oleoresinous with suspended zinc oxide pigment
3. Citrus Enamel	Citrus products and concentrates	Modified Oleoresinous
4. Sea foods Enamel	Fish products and meat spreads	Phenolic
5. Meat Enamel	Meat and various specialty products	Modified epons with aluminium pigment
6. Milk Enamel	Milk, eggs and other dairy	Epons

	products	
7. Beverage CAN enamel (non-carbonated)	Vegetable juices, fruit juice, highly corrosive fruits, non-carbonated beverages	Two-coat system with Oleoresinous type base coat and vinyl top coat
8. Beer Can Enamel	Beer and carbonated beverages	Two-coat system with Oleoresinous or polybutadiene type base coat and vinyl top coat.

5.6 CAN MANUFACTURING

Modern process is highly mechanized. Can bodies are formed at speeds as fast as 600 units per minutes

1. Interior Enamel and outside lithography if used are applied to flat sheets of plate
2. Coated sheets are cut into proper size for individual can bodies
3. "Body Blanks" are fed into bodymaker which notches, edges and curls the plate so that the opposite sides lock together
4. The four thicknesses of metal which meet at the side seam are "bumped" flat and soldered (tin solder) forming a cylindrical shell.
5. The flanger puts a flared rim on both ends of the can body
6. When needed, a second coat of enamel is sometimes sprayed into the formed can body
7. One end (bottom) is double-seamed into the can body and the can is tested under pressure.

CAN ENDS: Are stamped from enameled or uncoated sheets of plate which have been out into strips of proper size.

The edge of the end is curled to form a groove. Into the groove, a heavy liquid rubber sealant is flowed. This gasket-like material, when dried, provided an hermetic meal in the double seam between body and end.

One can end is double seamed at the factory. The second is double seamed by the packer.

5.7 CIRCUMFERENTIAL BEADS

Those are used on large cans to provide strength. It increases resistance to rough handling and improves can ability to withstand paneling pressure.

5.8 QUALITY CONTROL CANS

The can manufacturer assumes responsibility for quality of tin plate in finished product. Microscopic pores or flaws in the plate may expose base plate and accelerate corrosion. Micro examination is done. Tests have been devised for checking continuity of tin coating.

5.9 (a) Pickle Lag Test

Detinned sample in immersed in HCl. The rate at which H_2 is given off by corroding plate is recorded. Good plate is attached at a content rate throughout the test. Poor plate is attached critically.

(b) Iron Solution Value (ISV)

This simulates reaction with a filled tin can. It measures amt. of iron dissolved from a tin plate specimen immersed for several hrs. in acid solution

(c) Tin crystal size: test samples are etched for 10-15 seconds in acid solution, to bring out the pattern of crystals on the plate large crystals are desirable.