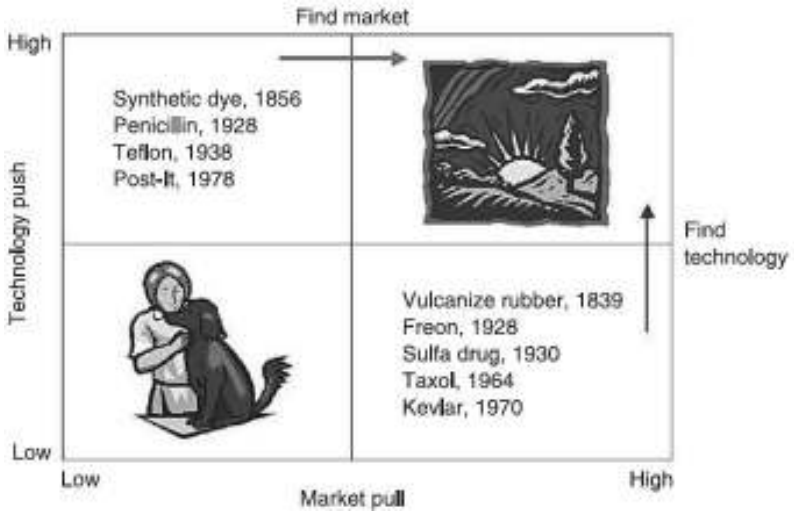
PRODUCT INOVATION

The evolution of an innovative product can be divided into four phases:

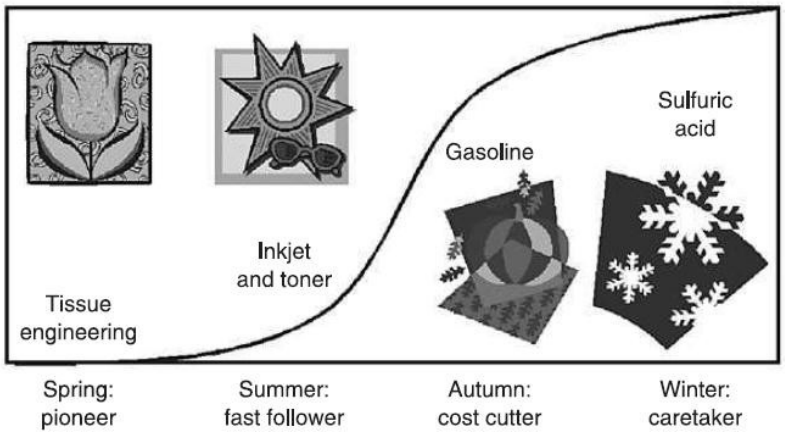
- The initial exploration – discovery – invention phase, creating a product concept.
- The development - design phase, making plans and blueprints to specific products and manufacturing processes.
- The commercialization phase, implementing the blueprints to make and to sell the products for the market.;
- The business and maintenance phase, monitoring outside responses to the new products and making continuous product improvements.

PRODUCT EXPLORATION AND DISCOVERY

HISTORIC of INNOVATIONS



PRODUCT LIFE CYCLE



FREON, CFC

Thomas Midgley, J.R.
-Mechanical engineer
-No formal education in chemical and chemical Engineering
-1921 invented TEL (tetraethyl lead)
-1928, CFC

Market Need Food Preservation Technology

Traditional method → drying

Another Technology:

-Lowering temperature (decrease the speed of bacteria growth)

- In 1748, William Cullen of Glasgow - first vapor compression refrigerator, and refrigerant was diethyl ether. the inhalation of ether will cause unconsciousness, and eventual death
- In 1859, Ferdinand Carré of France used ammonia as the refrigerant. ammonia can leak from the refrigerator and has a bad odor and irritating properties.
- In 1928 in the United States, and the refrigerants used were:
  - nitrous oxide (boiling point - 88 ^{O}C),
  - Ammonia (- 33 ^{O}C)
  - sulfur dioxide (- 10 ^{O}C)
  - methyl amine (- 6.7 ^{O}C),
  - butane (- 0.5 ^{O}C)
  - ether (34.6 ^{O}C)
  - chloroform (61 ^{O}C).

FREON, CFC

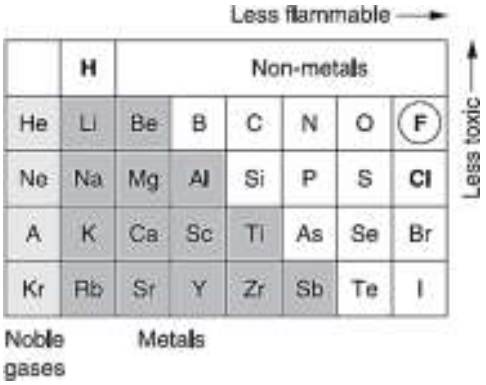
Refrigerant in that time:
-Toxic
-Flamable

→ Need new refrigerant

Possibility → Mixing of two substance to reduce toxicity and flammability

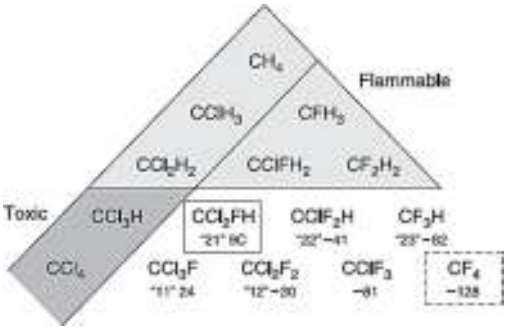
Desired compound → Boiling point 0 and -40, Stability, Nontoxicity, Nonflammability

FREON, CFC (Chlorofluorocarbons)



Midgley's analysis of refrigerant candidates

FREON, CFC (Chlorofluorocarbons)



Triangular diagram based on methane

FREON, CFC (Chlorofluorocarbons)

Reaction: 1 atm, 60°C for 24 Hr

$$CHCl_3 + 2HF \xrightarrow{SbCl_5} CHClF_2 + 2HCl$$

The product is washed with water and sodium hydroxide to remove the hydrochloric acid, and then distilled to separate the different forms of CFC.

Market-Pull Search for Technology

- Modifying current products
- Search for materials not currently used
- Creation of new synthetic material

Technology-Push

- Adapt "platform" technology to new markets
- Invention of new technologies

MARKET - PULL, SEARCH FOR TECHNOLOGY

- Start from identification of market that is not well served by current products
- Identification of potential market that presently doesnot exist

Divided into:

1. Modifying current product
2. Search for materials not currently used
3. Creation of new synthetic material

MODIFYING CURRENT PRODUCT

- Vulcanization of rubber – goodyear, 1839
- Celluloid-Hyatt, 1870
- Aspirin-Hoffman, 1898
- Tetraethyl Lead as Gasoline additive – Midgley, 1921

Vulcanization of rubber – goodyear, 1839

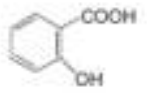
- In 1839, Rubber, when mixed with sulfur and heated, becomes vulcanized, remaining elastic in cold weather and avoiding tackiness in hot weather.
- The formula was 100 parts rubber + 5 parts sulfur, heating to 141 ◦F for 3–4 h. The disulfide bonds formed between strands of rubber chains, turning one-dimensional raw rubber chains into a cross-linked three-dimensional network of chains.
- John B. Dunlop of Britain founded the tire industry by patenting and developing pneumatic tires for bicycles and tricycles in 1888.

Celluloid-Hyatt, 1870

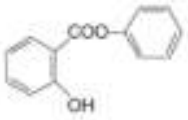
- Celluloid is a tough material, with great tensile strength, and is resistant to water, oil, and dilute acid. It can be made at low cost in a variety of colors.
- Celluloid was used to stiffen collars, for laminated safety glasses, spectacle frames, piano keys, and photographic films.
- John Hyatt was attracted to develop an alternative to ivory for billiard balls.
- He combined nitrocellulose, camphor, and alcohol, heated the mixture under pressure to make it pliable for molding, and allowed it to harden under normal atmospheric pressure.

Aspirin-Hoffman, 1898

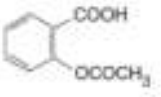
- Aspirin is one of the most important drugs used as an antipyretic (lower fever) and as an analgesic (relief pain) (Korolkovas 1988).
- Carl Buss administered salicylic acid to typhoid patients (1875).
- In 1883, von Nencki reacted phenol with salicylic acid to produce salol,.
- Felix Hoffman of Bayer laboratories, He searched on aspirin, which was synthesized earlier in 1853.
- In 1898 Bayer patented the processes used in large-scale manufacturing instead, and bestowed the proprietary name of "aspirin" on the compound.



salicylic acid



salol



acetylsalicylic acid

Tetraethyl Lead as Gasoline additive – Midgley, 1921

SEARCH FOR MATERIALS NOT CURRENTLY USED

-Ether as anesthetic – Morton, 1846
-Incandescent Lamp-Thomas Edison, 1879
-Chlorination of drinking water, Chicago, 1908
-Sulfa drug – Gerhard Domagk, 1930
-Dichlorodiphenyltrichloroethane, Muller, 1939

CREATION of NEW SYNTHETIC MATERIAL

-Salvarsan-Ehrlich, 1909
-Kevlar, DuPont, 1970

Investigator have technology that they believe has potential

A platform technology is a technology successful in one or more markets and has more potential application in more markets

Examples:
-Sandpaper to mending and recording tapes
-Botox to remove skin wrinkles

INVENTION OF NEW TECHNOLOGIES

Starting point of greatest invention → discovery of new technology

-Synthetic dye-Perkin, 1856
-Penicillin-Fleming, 1928
-Nylon, Carothers, 1938
-Teflon-Plunkett, 1938
-Post it- silver and Fry, 1964