

# Iron and Steel Industry

The growth and development of iron and steel industry is a reflection of global economy. The iron and steel industry depicts a changing nature in its growth and production pattern. In the mid-1970s, the relatively developed countries of North America, Western Europe and Japan accounted for nearly two-third of the world's steel production. But gradually the spatial pattern has changed and attention has now shifted to the developing regions.

Towards the end of the last century, the growth of steel production in countries like China, South Korea, Brazil and India has changed the entire pattern of steel production in the world.

Now main producers of iron and steel in the world are China, Japan, USA, Russia, Germany, South Korea, Brazil, Ukraine, India, France, Italy and Great Britain. The other steel-producing countries are South Africa, Australia, Austria, Netherlands, Czech Republic, Romania, Spain, Belgium, Sweden, etc. Indicates the production of iron and steel in major countries of the world.

## **Physical factors for the localization of an industry in a particular area are:**

- **1.Raw material:** The location of industrial enterprises is sometimes determined simply by location of the raw materials.
- **2. Power:** Regular supply of power is a prerequisite for the localization of industries. Most of the industries tend to concentrate at the source of power.
- **3. Climate:** Climate plays an important role in the establishment of industries at a place. Cotton textile industry requires a humid climate consequently majority of cotton textile mills are concentrated in Maharashtra and Gujarat.

# Production of iron and steel in major countries of the world:

	Production (in crore tons)	
	Countries	Crude steel
China	131.23	128.5
Japan	80.5	105.4
USA	47.9	102.0
Russia	43.3	55.5
Germany	27.3	41.7
South Korea	24.8	43.4
Brazil	27.7	27.8
Ukraine	25.7	31.7
India	21.3	26.9
France	13.6	20.0
Italy	10.9	26.6
Great Britain	10.9	16.1

- It becomes clear from the table that China is the leading producer of iron and steel in the world, which accounts for about 23.9 per cent production of pig iron and 17 per cent of crude steel of the world's production.
- Japan is the second largest producer with 14.7 per cent pig iron and 13.9 per cent crude steel production of the world.
- USA once the highest producer now ranks third in the world followed by Russia. India's position is 9th in the iron and steel production and its production of pig iron and crude steel accounts for 3.9 and 3.6 per cent respectively.
- The spatial distribution pattern of iron and steel industry in major countries of the world is as follows

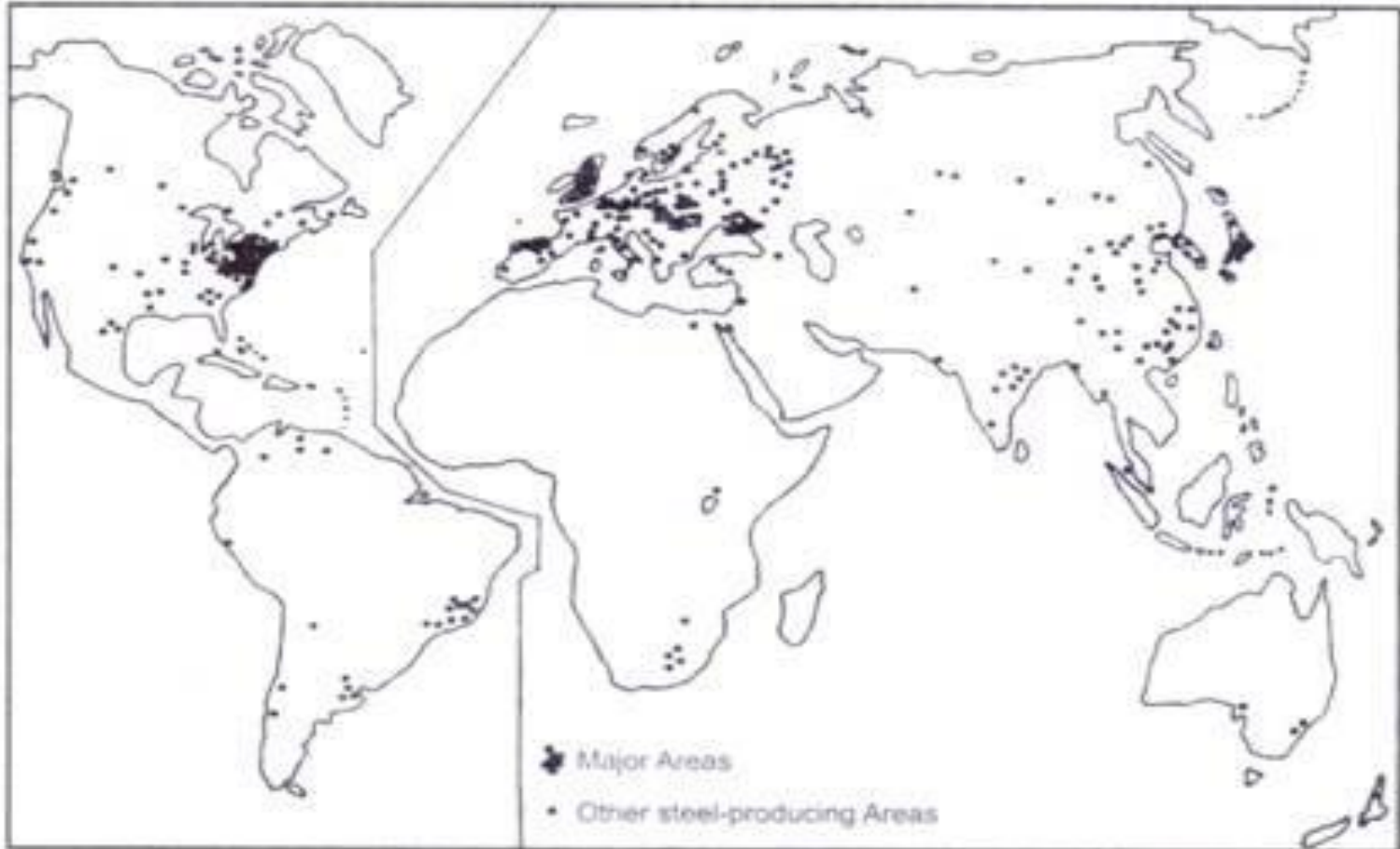
# 1. China:

- China is having the oldest system of fabricators of iron, as is evident from its historical records. But until the adoption of her five-year plan in 1953, China had only insignificant iron and steel manufacturing of modern type.
- Gradually, China has developed the iron and steel industry and now it is the highest producer of iron and steel in the world.
- Since 1973, growth of steel production in China was spectacular and within a span of 15 years China was able to increase its production of crude steel to 217 percent. In that period consumption increased 300 per cent. This growth rate clearly reveals the rapid pace of industrialization that is now going on in China.

# Distribution of Iron and Steel Producing area in the World

**Figure 10.1**

Distribution of iron and steel-producing areas in the world



- The iron and steel industry is concentrated in Anshan, Wuhan and Paotow triangle. The biggest iron and steel factory was established in the Chinese mainland at Anshan in Manchuria by Japanese, but was greatly expanded by the Chinese with Russian help. Other iron and steel production centres in Manchuria are Fushun, Penki, Shenyang, Harbin and Kirin.
- For Wuhan plants, ore is obtained from Taiyuan, i.e., 130 km away, and coal from Pingtinghan to the north of Yangtze River. The Wuhan steel plant is also in process of expansion. Other less extensive new steel plants are being created in Siangtan (Hunan), Tientsin, Tangshan, Nanking, Shanghai, etc.



## **At present, China is having following important areas of iron-steel industry:**

- (i) Southern Manchuria is the largest steel plant of China at Anshan and other plants at Pensihu and Mukden.
- (ii) Shansi is also an old region of iron and steel production. In this region Taiyuan has been developed as a major steel centre.
- (iii) The Lower Yangtze Valley: In this region Hankow, Shanghai, Hanyang and Chungking are the main centres of iron and steel industry.
- (iv) Other centres are located at Paotow, Chinling Chen, Canton, Singtao and Huangsih.
- The growth of iron and steel industry in China has been spectacular. Since 1973, China has increased its production of steel by 220 per cent, although her consumption of steel has also increased more than 300 per cent.

## 2. Japan:

In spite of the shortage of raw material (iron and coal), Japan has become one of the leading steel producers of the world. After China, Japan is the second largest producer of pig iron and crude steel in the world.

### **Centers of Steel and iron Industry in Japan:**

Centres of iron and steel industry in Japan



- Yawata, the first steel plant was built in 1901 by government. Yawata is a major centre of heavy industry with about one fifth of Japan's steel capacity. Kamaishi in Honshu and Muroran in Hokkaido are small tidewater plants.
- The number of large-scale plants directly connected with regional mineral resources and those plants are only in Kamaishi, Kosaka, Osarizawa, Hassei (Akita), Hosokura (Miyagi) and Fujine (Iwate).
- Over half of the Japan's steel capacity is concentrated near the major port cities of Himeji, Kobe-Osaka and Tokyo-Yokohama areas of South Central Honshu.
- Almost all the iron and steel plants of Japan are situated near tidewater. These steel plants, at or near tidewater, are thus able to draw raw materials from many parts of the world and similarly to ship finished products.

**In Japan, large-scale concentration of iron and steel industry has occurred in the following regions:**

### **1. The Tokyo-Yokohama Region:**

It is having all facilities required for the growth of iron-steel industry. The reclamation of Tokyo Bay provided large, extensive plane land for steel manufacturing units. The Tokyo-China region is the main area in which steel industrial units have been developed at Hitachi and North Tokyo.

### **2. Nagoya Region:**

It contributes about 20 per cent of the Japanese steel production. This region had witnessed a massive growth of industries within the period 1950-60.

### **3. Osaka-Kobe Region:**

At the head of the Osaka Bay, a highly industrialized area known as the Kinki has developed. The port of Osaka is the main center. Other centers of this region are Amagasaki, Kobe, Hemegi, Sakai and Wakayama.

### **4. Fukuoka-Yamaguchi Region:**

It is located in the extreme south of Japan within Kyushu and westernmost end of Honshu. The first government steel plant was established at Yawata in 1901. Kita-Kyushu is another notable iron and steel center of this region.

### **5. Oka-Yamaha Region:**

It is a new industrial region situated in between Osaka-Kobe and Hiroshima.

## 6. Hokkaido Region:

The main center of this region is Murroran. A fairly big sized iron and steel industry has developed here depending upon local coal and iron ore.

- The most striking feature in the locational pattern of Japan's steel plants is that they are situated either on the Bay-Coast or on some canal or river. This is because of the fact that most of the Japanese steel plants depend upon outside raw material. Another feature is that they are located in the heart of great industrial districts which provide ready market for finished steel. In fact, localization of iron and steel industry in Japan is market-oriented.

### **3. United States of America:**

Once USA was the highest producer of iron and steel but now its rank is third in the world, next to China and Japan. In the US first iron and steel plant was established in 1629 at Massachusetts. During last 380 years or so the US steel industry has undergone through several changes. This change has not only occurred in growth and production pattern but also in localization pattern. The major iron and steel regions in the USA are as follows:

#### **(i) Appalachian or Pittsburgh Region:**

The most important of all the regions is the northern Appalachian region of western Pennsylvania and eastern Ohio. This district contains about 42.5 per cent of the blast furnace capacity of the country and its center, Pittsburgh, is the second greatest center of steel industry in the world. The mills in this region are located almost exclusively in the narrow valleys of the headwater streams of the Ohio River, including the upper reaches of the Ohio itself.

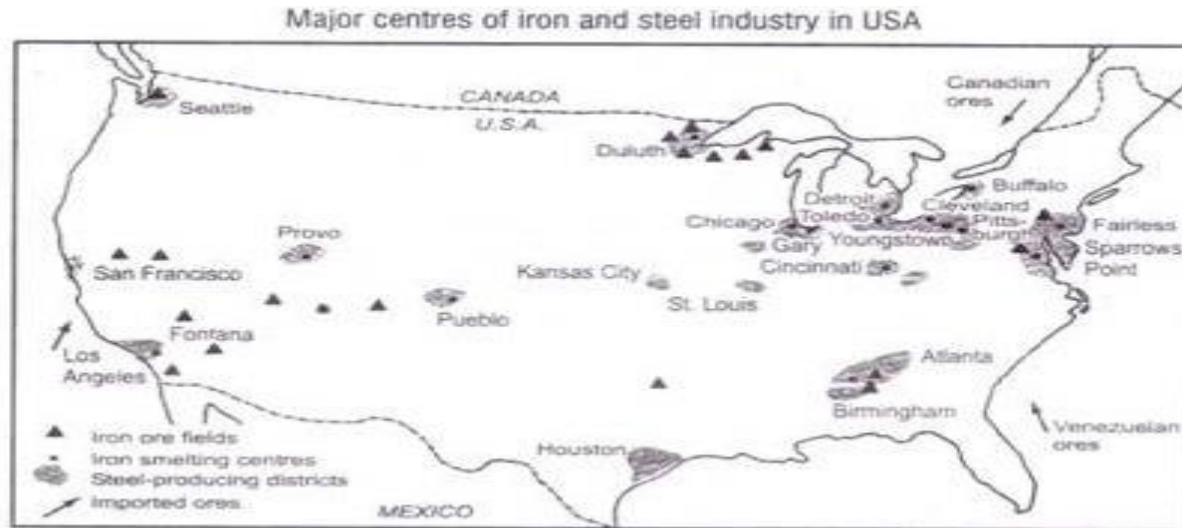
- The region, often known as the Pittsburgh-Youngstown region, includes several districts. The Pittsburgh district consists of industries located in the valleys of the Ohio, Monongahela, and Allegheny, within 60 km of Pittsburgh.
- The Youngstown or the ‘valley’ districts consist of industries in the valleys of the Shenango and the Mahoning rivers.
- Wheeling, Johnstown, Stephenville and Beaver Falls are other important steel-producing centers. The chief disadvantage of the region is its remoteness from the sources of iron ore supplies, which come from the Lake Superior region partly by rail and partly by water.

## **(ii) Lake Region:**

- **The lake region falls into:**

- (a) The Lake Erie ports; Detroit, Cleveland and Buffalo, etc.;





- (b) The centers near the head of Lake Michigan, Chicago-Gary or Calumet district; and
- (c) The Lake Superior region, Duluth. These districts represent a somewhat different adjustment to the three factors in the localization of the industry, coal, iron and market. The Lake Erie ports are nearer to the Appalachian coal, but farther from the iron ore than the Duluth region.

- The Michigan region is midway between the two. One important advantage that all these districts enjoy over the Pittsburg region is that, owing to their location on the lake shores, one extra handling of iron ore is eliminated.
- On the other hand, these centers are located a little away from the market. Duluth, for example, has in its immediate hinterland the forest, farm, and the ranching country, with little demand for iron and steel goods.
- Detroit is the largest steel consuming center in the USA particularly because of its automobile industry.

### **(iii) Atlantic Seaboard Region:**

- On the Atlantic Seaboard, it is only the Middle Atlantic region (New York, Philadelphia and Baltimore, etc.) that is important. The chief advantage that this region enjoys is in respect of its location, both in relation to the tidewater, and the proximity to the large industrial centers of the East.

- Its location near the center of the great manufacturing region of the Atlantic Seaboard, the region of the densest population, and of the most intense industrial development in North America, is the most remarkable.
- The Middle Atlantic region is the only major region in which the production of pig iron and steel is notably greater, in proportion, than the iron ore consumed, because of the relatively larger amounts of scrap available in this highly industrialized region.
- There are many steel mills in this region which operate without blast furnaces, depending both on scrap and pig iron imported from other areas, particularly the Northern Appalachian region.

#### **(iv) South Appalachian:**

- In the Southern Appalachians, in Alabama, however, large deposits of these raw materials are found in closer proximity than anywhere else in North America if not the world. While the ore is of low grade and requires shaft mining, much of the rock is lime and the ore is, therefore, self-fluxing.
- The region lacks, however, large industrial centers in the neighborhood and has, therefore, a considerable amount of surplus pig iron which goes to the North.

#### **(v) Western Region:**

- This region extends from Colorado in the interior to the California on the west. Among the steel region in the USA, this is a new region. The first steel mill, although had been setup in 1882 at Pueblo. Later on steel industries were developed at Fontana in California and Provo at Utah. For these plants, iron ore is obtained from Wyoming and coal from Colorado.

## 4. Russia-Ukraine (erstwhile USSR):

- Prior to disintegration in 1991, USSR was the leading steel-producing country of the world. Now also Russia and Ukraine are important iron and steel producers of the world. Russia ranks 4th in the production of pig iron and crude steel, while Ukraine stands 8th in world ranking.
- In the post-revolution period, the Soviet steel industry had achieved a remarkable expansion. During the Second World War, however, the Soviet iron and steel industry was affected badly.
- Most of the large production center's were either destroyed or damaged. However, soon the country recovered and by 1975 became the largest producer of iron and steel in the world.
- The four important iron- and steel-producing regions are:

### **(i) Ural Region:**

- It lies on both sides of the Urals. The major steel centers of this region are – Magnitogorsk, Chelyabinsk, Nizhny Tagil, Sverdlovsk, Serov, Perm, Orsk, etc. Magnitogorsk is the largest steel-producing centre of Russia.

### **(ii) Kuznetsk or Kuzbas Region:**

- It is located in the north of the Alai Mountains and south of Tomsk. This steel region is coal-based. The supply of iron ore is from the Ural region. Novokuznetsk is the leading steel centre of this region.

### **(iii) Moscow Region:**

- Important centers of iron and steel in this region are Tula, Lipetsk, Cherepovetsk and Gorky.

### **(iv) Others:**

- Other regions are isolated and developed in various parts. These are Baikal, St. Petersburg, Lower Amer valley and Pacific coastal region.

## 5. Ukraine:

- Now, Ukraine is an independent country and has 8th position in world's production of iron and steel. In this region all the raw materials, i.e., iron ore, coal, limestone, manganese are available for steel production.
- A dense network of railways and cheap water transport facilitate the growth and development of iron and steel industry. The main centres of iron and steel plants are Krivoirog, Kerch, Zhdanow, Tagarerog, Zaporozhye, Pittsburgh, Dniepropetrovsk, etc.
- Other notable steel-producing centres of independent countries are Tbilisi, Tashkent and Bogovat in Uzbekistan and Tamir Tan in Kazakhstan

## 6. Germany:

- Before World War I, Germany was the second largest iron and steel producer in the world. It was the largest exporter of steel goods in the world. German iron and steel industry was handicapped since after the war of 1914 by the loss of ore, coal and productive capacity.
- Germany, however, made a remarkable recovery within a few years, and in spite of her depleted resources she produced in 1939 more than the 1913 production of steel. In 1937 she had established the great Hermann Goering Steel Works at Salzgitter to utilize the grade ores in its Harz Mts.
- The division of Germany was the main cause of lower status in terms of iron and steel production. But after re-unification of East and West Germany in 1990, the country is now one of the leading steel-producing countries in the world and ranks 5th in the world with an annual production of 27.3 crore tons of pig iron and 41.7 crore tons of crude steel.



- The most important center of iron and steel industry in Germany is the Rhenish-Westphalia, contributing more than 80 per cent of the steel produced in Germany, and 85 per cent of pig iron. It manufactures a wide variety of specialties.
- Other regions of importance are the Siegerland Hessen-Nassau, Northern and Central Germany, Saxony, and South Germany. The greatest center is Essen in the Ruhr valley where the world famous works of Krupp are situated.

## 7. South Korea:

- South Korea is the 6th leading country of the world in iron and steel production. It is the third Asian country after China and Japan which produces high-grade of steel. Its annual production is 24.8 crore tons of pig iron and 43.4 crore tons of crude steel.

## 8. Brazil:

- Brazil is the 7th ranking country in iron and steel production in the world. Its annual production is 27.7 crore tons of pig iron and 27.8 crore tons of steel.
- The development of the production of steel in Brazil has been spectacular. Since 1973, production of steel has witnessed more than 300 per cent increase. The consumption of steel within the country is very low.
- Therefore, Brazil is able to export bulk of her steel production. Most of the steel industries are located around Sao-Paulo and Curumba.
- Brazil possesses vast amount of iron ore. The largest of these deposits is located near Minas-Gerraes. Another large steel plant is located at Santa Catarina. Most of the mills obtain energy from hydel-power plants.

## 9. India:

- India has a long history of the use of iron and steel. However, it was only after the first decade of the 20th century that manufacture of iron and steel as a modern industry made a beginning in this country. It was in 1911 that India's first iron and steel plant – the Tata Iron and Steel Company Ltd. (TISCO) was set up in Jamshedpur in Bihar in private collaboration with a US firm. Nearly three and a half decades later another plant was launched at Burnpur in neighboring Bengal the Indian Iron and Steel Company Ltd. (IISCO) with British participation.
- At the commencement of Five-Year Plans (1951) there were three steel plants located at Jamshedpur, Asansol and Bhadravati. Not only capacity of these plants was increased but six integrated plants in public sector have been established at Durgapur, Rourkela, Bhilai, Bokaro, Vishakhapatnam and Salem, Apart from these more than 140 mini steel plants have also been set up to meet the growing internal demand. India is having the largest iron ore deposits in the world and also having coal, therefore, having very good prospects of the further growth of iron and steel industry.

## 10. France:

Till 1973, France was the 6th largest producer of steel in the world but now its position is 10th. France is the biggest iron ore-producing country of West Europe but there is scarcity of coal. In France, two regions are notable for iron and steel production.

**These are:**

**(i) Lorraine, and**

**(ii) Sambre-Meuse.** Metz, Briey, Nancy and Longway are notable steel centres of Lorraine region, while Clermont Ferrand, Le Creusot, St. Etienne, Lille, Valenciennes, Le Harre and Marseilles are important centres of Sambre-Meuse region. In Saar basin also, steel industry has developed on local coal deposits and iron ore from Lorraine.

## 11. Great Britain (UK):

- Great Britain was not only the pioneer but a leading steel-producing country in the world for a long time. But its decline started in the first quarter of the 20th century. Now once again Great Britain has been able to establish itself as one of the important iron- and steel-producing countries and ranks 12th in the world.
- The main advantage of UK's iron and steel industry is that most of the centers are well-situated in relation to their coal and ore supplies and also have good facilities of importing raw material and exporting finished goods.
- The most important steel-producing centers of UK are as follows:
  - 1. North East Coast (Middles-borough, near New Castle, is the largest producing center, and has the most modern equipment in Britain's industry).
  - 2. Derby, Leicester, etc.
  - 3. South Wales (Cardiff).
  - 4. Lincolnshire.
  - 5. West Coast.
  - 6. Scotland (Glasgow).
  - 7. Sheffield and Birmingham (the oldest, but not the most outstanding).
  - 8. Staffordshire.

## **12. Italy:**

- Italy now has emerged as a leading iron- and steel-producing country not only of Europe but of the world. It ranks 11th in the world's production of iron and steel. Italy's annual production is 10.9 crore tons of pig iron and 26.6 crore tons of crude steel.
- Although Italy is having shortage of both coal and iron ore but it has developed this industry through well-planned management. The major steel plants of Italy are located at Naples, Genoa, Aosta and Trieste.

## **13. Poland:**

- Poland is an important producer of iron and steel in Europe. The main steel plants of Poland are located at Glewicz and Gracow.

## **14. Czech Republic:**

- Iron and steel industry is moderately developed in the country. The largest steel plant in the country is Skoda steel plant.

### **15. Sweden:**

- Sweden is very rich in her iron ore reserves. Energy is obtained from cheap hydel-power. Swedish steel is of very high quality. The best quality steels are generally exported. This country is not self-sufficient in ordinary steel production.

### **16. Holland:**

- This country is deficient in both iron ore and coal. As most of the steel plants are new, productivity rate is very high. The country has to import large amount of steel for domestic consumption.

### **17. Australia:**

- Australia is very rich in coal deposits. Most of the steel plants are new in Australia. So, the productivity is very high. The important steel plants are New Castle and Port Keembla.

### **18. Canada:**

- The Canadian steel industry is not very old. Most of the iron and steel centres were developed around Lake Ontario, Sydney, Nova Scotia. Canada is self-sufficient in the production of iron ore and coal.
- Most of the coal reserves are located within Nova Scotia and iron ores are located around Sydney. Apart from that, steady supply of iron ore and coal from adjacent USA has enabled Canada to develop a large steel industry. Some of the major steel plants are Hamilton, Sault Ste, Ontario, Sydney, etc.



- **19. Mexico:**

- Mexican steel industry is as old as American steel industry. The largest steel plant is located at Monterrey. The others are Monclova, Coahuila, Piebras, Negras and Colima. The coal is obtained from Salinas area and iron ores from Durango.

- **20. South America:**

- In South America, apart from Brazil, steel plants have been established in Argentina, Chile, Uruguay and Venezuela.

- **21. Africa:**

- The largest steel producer of Africa is the South Africa. In South Africa steel plants are located at Transvaal and New Castle. In other African countries, iron and steel industry has not yet been developed properly.

- **22. Asia:**

- In Asia, apart from China, Japan, South Korea and India, steel industry has also been developed to a limited extent in Turkey, North Korea, Iran, Taiwan, Malaysia and Vietnam.

**Thanks**

# ALUMINIUM INDUSTRY

## Importance of Aluminium

Did you know aluminium (or aluminum) is present in more than 270 minerals? It is lightweight and malleable and thus makes aluminium a popular metal that we use for day-to-day living. It's a multi purpose metal, used for aluminium foil to wrap up leftover to manufacturing home appliance. We use aluminium everywhere.

The metal was made popular in home appliance by apple. The creative geniuses created a laptop made from aluminium, because, it is a cost effective metal, easy to source and find.

## **Aluminium has made our life convenient**

From the most used item in your home to the ones hidden away from sight, almost every appliance features aluminium. Here are items you may have at home that features this versatile metal.

### **Pot and pans**

Take a look inside your kitchen's cabinets. It is a metal regularly used to manufacture cooking utensils. Though highly reactive, it is often present in cooking appliances because it forms protective layer when exposed to air.

## **Soda cans**

Almost any person has had a drink from a soda can or at the least seen one. Did you know these cans are made from aluminium? A soda can is no stranger to this useful metal. Here is how and why

This precious metal is infinitely recyclable. These cans can be recycled and repurposed over and over again. No wonder it is one of the foremost reasons for using aluminium in soda cans, and that's why cans have a lower carbon footprint compared to glass and plastic.

The cans are lightweight which is convenient for stacking and shipping, too. Cans protect and preserve the flavour of your favourite drink. Its superior quality makes it a good canvas. Therefore soda manufacturers can easily print their logo and design on the body of cans.

## **Home appliances**

The silvery –white metal is an excellent conductor of electricity. This is why you will find it in your refrigerators, microwaves, and in most home appliances. Aluminium is used in nearly every appliance in your home, from televisions to your dryer. Its lightweight nature makes it the most sought-after metal in appliance manufacturing. The transport of these appliances becomes convenient too.

It has good thermal conductivity. This makes it a go to metal in the manufacture of heating and cooling appliances.

## **Wheels**

The most prominent characteristics of the aluminium metal is its ability to withstand weight. It is the right alloy with the strength of steel. This property comes in handy when manufacturing wheels for heavy vehicles. Heavy vehicles like trucks transport heavy loads. These need the aluminium wheels to easily withstand the load pressure.

## **Wiring**

Aluminium is ductile, which mean it is drawn in to wires. Along with the property of electrical conductivity, it is suitable for wires and wiring.

# Packaging

Aluminium is often seen in packaging as it is lightweight and holds heat. To make a roll of aluminium foil, the metal of passes through rolling mills at a particular pressure. This is done to get the right thickness. It is than cooled and sent to the cold rolling mill to prevent breakage.

Aluminium foil is present in most homes and food industries. This everyday use of foil helps pack food and line cooking pans. It not only retains the temperature of the food, but it also protects it. The metal prevents oxygen, moisture and bacteria from damaging the food.

Pharmaceuticals use aluminium in their packaging as well. This is because it can store perishable goods without needing refrigeration.



The way you look at it, aluminium is the superhero of all metals. It has properties that protect. Prevent damage and is wholly recyclable. Furthermore it is plentiful and easily recyclable. Recycling aluminium pays fairly well in south florida as well. So go green by buying more aluminium products. It is friendly on the environment and on your pocket.

## List of Countries by aluminium production

Rank	Country/Region	Aluminium production (thousands of metric tons)	Year
1	China	33,000	2018
2	India	3,700	2018
3	Russia	3,700	2018
4	Canada	2,900	2018
5	United arab emirates	2,600	2018
6	Australia	1,600	2018
7	Bahrain	1,540	2018
8	Saudi arabia	916	2017
9	United america	890	2018
10	South africa	716	2017
	<b>World</b>	<b>51,562</b>	

Source: World mineral production 2013-2017 British Geological Survey.

Thanks

# Paper and pulp industry

## Introduction

- The pulp and paper industry converts wood or recycled fibre into pulp and primary forms of paper.
- First mechanical and then chemical methods have been developed to produce pulp from wood.
- Pulp mills separate the fibres of wood or from other materials, such as rags, wastepaper or straw in order to create pulp.
- Paper mills primarily are engaged in manufacturing paper from wood pulp and other fibre pulp, and may also manufacture converted paper products.

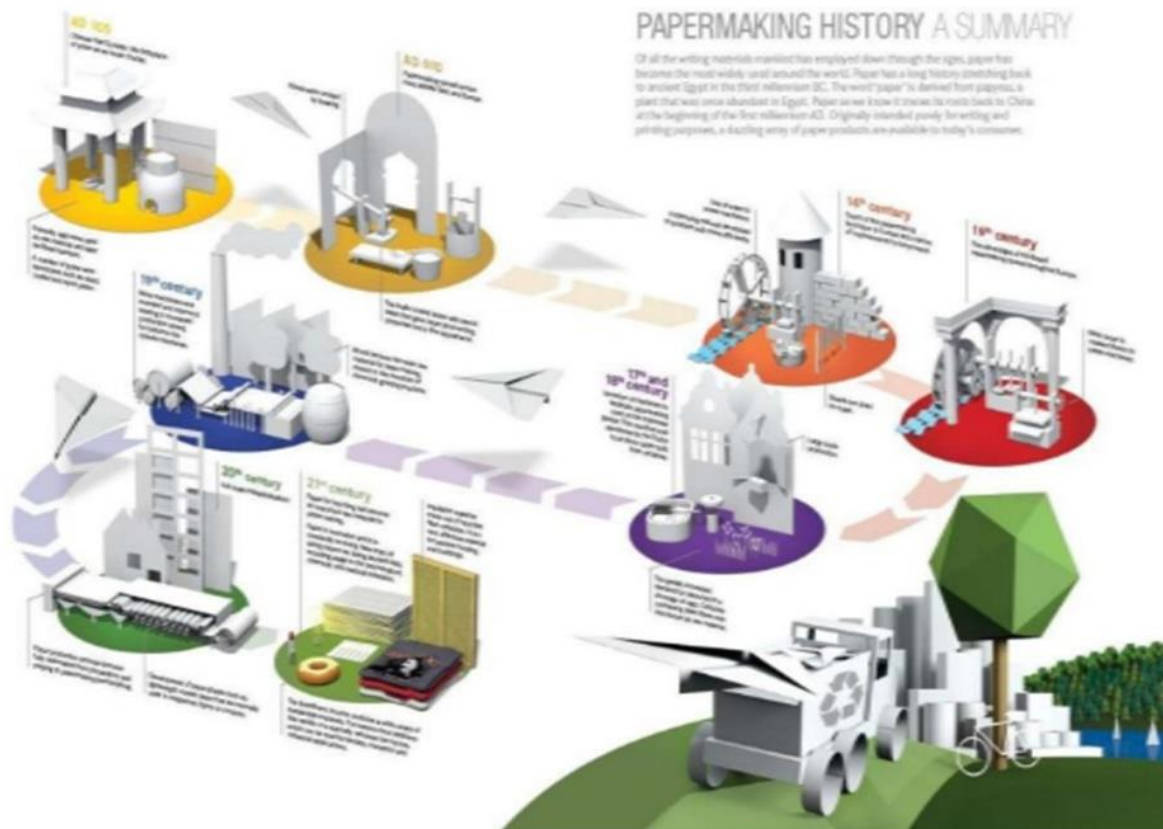
# History

- The earliest paper was made from papyrus grass in Egypt.
- Papermaking has traditionally been traced to China about 105 AD by Cai Lun
- Chinese paper making techniques became more specialized over the next few centuries with sized, coated and dyed paper, and paper with insect protection



## PAPERMAKING HISTORY A SUMMARY

Of all the writing materials mankind has employed down through the ages, paper has become the most widely used around the world. Paper has a long history stretching back to ancient Egypt in the third millennium BC. The word "paper" is derived from papyrus, a plant that was once abundant in Egypt. Paper arrived in Europe from its roots in China at the beginning of the first millennium AD. Originally intended purely for writing and printing purposes, a vast array of paper products are available to today's consumer.



## Properties of pulp can be determined by:

- Ash content in pulp but it is not important parameter of pulp.
- Dirt content of pulp particularly of recycled pulp is important for its suitability to make fine paper.
- Moisture Content of Market Pulp is important from storage, transportation and handling point of view.

## Uses of the product

- Around the world we use more than 1 million tons of paper every day.
- Our paper consumption is escalating, particularly in emerging markets such as China.
- Paper is a versatile product with many end uses varying from household papers, graphic and office papers to medical papers.



- 50% of the paper and board produced globally is used for packaging.
- The second largest market for paper is printing and writing.
- 400 million tons/year: Global paper consumption as of 2010. Half of this is consumed by Europeans and North Americans and is thrown away after a short time.
- 500 million tons: Forecasted increase in paper consumption by 2020.

# Pulp and Paper Process

The production process can be divided into 7 sub-processes:

- raw materials processes;
- wood-yard;
- fibre line;
- chemical recovery;
- bleaching;
- paper production;
- products and recycling.

## Raw material Process

- Wood is the main fibrous raw material used to produce pulp, and accounts for more than 90% of the production.
- Non-wood fibres are an important source of raw materials, especially in developing countries.
- Manpower requirements and the safety of workers and populations must be an issue of concern for investors.

## Raw material storage and preparation

- Preparation of the raw material is necessary before it enters the papermaking process.
- Wood, for instance, first needs to be debarked usually by mechanical or hydraulic processes, and is then disintegrated, generally by chipping into particles of the adequate size.

# Pulping

- The goal of pulping is to separate the fibres from the material
- There are 3 different groups of pulping methods,
  1. Mechanical pulping, This method consists in grinding raw material against an abrasive surface to defibre the raw material (more generally softwood) without any lignin dissolution.

2. Chemical pulping, this method separates the fibres from the raw material by making soluble all the non-cellulosic components in a cooking liquor at high temperature and pressure. This pulping gives better quality but greater pollution.

3. Chemi-mechanical pulping, involve a chemical pre-treatment of the raw material, before a mechanical treatment to liberate the fibres.

# Bleaching

- Pulp for packaging material can generally be used without bleaching. For other purposes, it has to be bleached.
- In mechanical pulping most common agents are sodium or hydrogen peroxide and sodium hydrosulphite used alone or in combination.
- In chemical pulping chlorine, sodium or calcium hypochlorite and chlorine dioxide are used.
- Oxygen pre-bleaching becomes more important in order to reduce chlorine use.

# Papermaking

- The five main paper grades listed in decreasing order of production volume are: (French statistics)
- Cultural paper: newspaper, books, writing paper... 46%
- Packaging paper: kraft for packaging, corrugated paper... 37%
- Paperboard: 9%
- Industrial paper: cigarette, sensitized paper, dielectric, checks, filters.. 3%
- Tissues: toilet paper, handkerchiefs, napkins... 5%



## SHE consideration


- Safety :
  - Machine intervention
  - Slips trips and falls
  - Work at height
  
- Health :
  - Noise
  - Dust

# Environmental problems

- Air emissions - Nitrogen dioxide and sulfur dioxide are major contributors of acid rain.
- Deforestation
- Water pollution - **solid waste** such as sludge derived from their pulping and bleaching operations.
- Solid wastes - Dirty wood chips or fibers as well as bark

## Energy use

- The pulp and paper industry uses 84% of the **fuel energy** consumed by the forest products industry as a whole.
- It is one of the largest producers of greenhouse gas (GHG) emissions.
- Over the past few years, the pulp and paper industry has considerably reduced its GHG emissions by introducing energy conservation projects and by increasing its use of biomass as an energy source.



What we can do to  
save our  
environment???

# Recycling

In Europe an average of 56% of used paper is recovered. The recycling process includes following stages:

- Sorting
- Dissolving
- De – inking
- Mixing
- Papermaking process



# Genetically modified trees

- Lignin is the main wood component that must be effectively removed from the pulp.
- It has been possible to use genetic engineering to modify lignin content and/or composition in poplars.



## Price aspects of this process

- The production cost was calculated to be 670 euros/t of hemicelluloses.
- This is approx 9 times lower than the price of ethylene vinyl alcohol, which is produced by petrochemicals and is currently used as an oxygen barrier in fiber-based packaging materials.

Thanks