SUSTAINABLE MINING AND GEOINFORMATION

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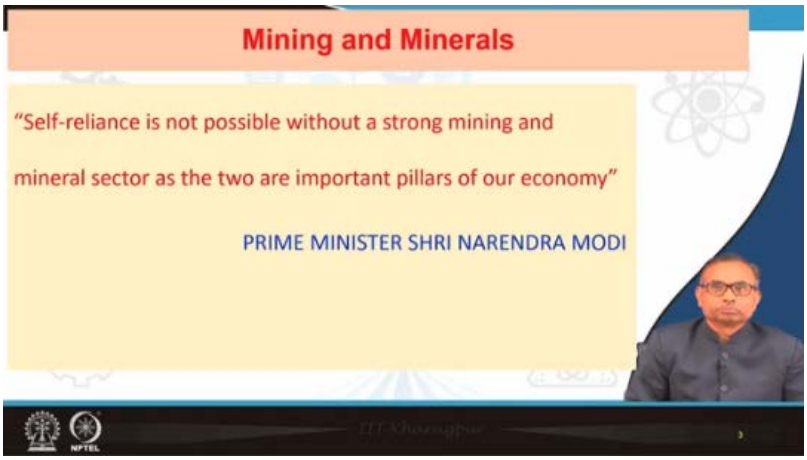
Week – 05

Lecture 21: Minerals, Mining, and Society - I

Welcome students to today's lecture on sustainable development. So, today, we will discuss the class on minerals, mining, and society. This is the twenty-first lecture of our NPTEL course, and the topic is "Mineral, mining, and Society." We will have two lectures, and today is the first lecture. The twenty-second lecture will be the second lecture on this topic. So, we will cover the topics in today's class. First is the role of minerals in society and the economy. Then, we will discuss the role of minerals in the journey of civilization.

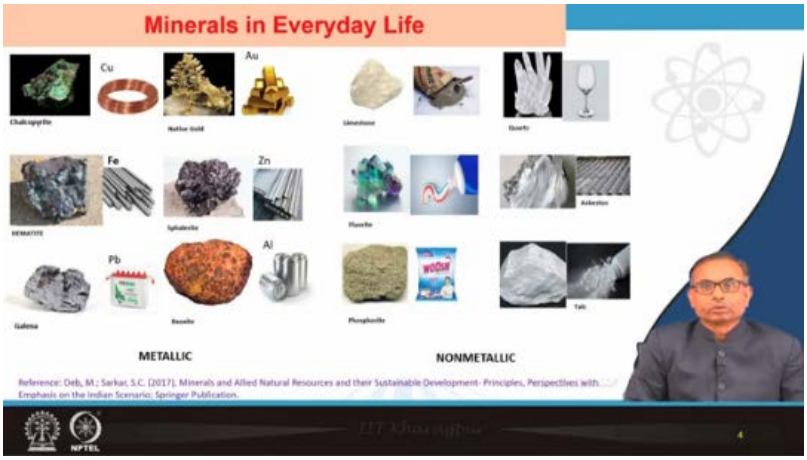
Then, we will talk about the classification of minerals and the Indian economy. We will also discuss some uses of major minerals, particularly the metallic minerals today, and conclude this class.

So, as we know, the mining sector and the mineral sector are important sectors of the Indian economy, and I am just quoting Prime Minister Sri Narendra Modi: 'Self-reliance is not possible without a strong mining and mineral sector, as the two are important pillars of our economy.'



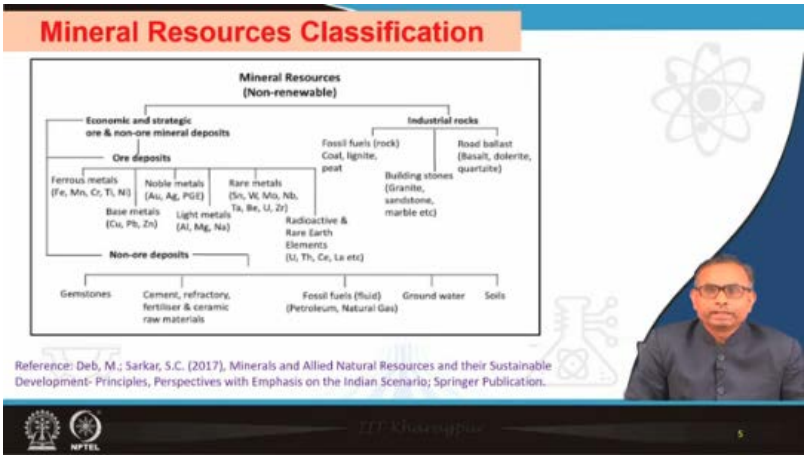
So, this shows the importance of the mining and mineral sectors for the Indian economy, particularly when we are talking about Atmanirbhar Bharat or a self-reliant Bharat. In that, the minerals and mining industry has a big and important role.

We all know that minerals are very important in our day-to-day life. And we are using so many minerals in our everyday life. You can see this picture that we are using many metals in our day-to-day life: copper, gold, limestone for making cement, quartz for making glass products, iron, and steel. We all know the importance of iron and steel, then other minerals like fluoride, which we are using for making toothpaste, and asbestos, galena, which is the PV we are using in batteries, and bauxite used in making aluminum sheets, phosphorides for making detergents. Like so many minerals, whether they are



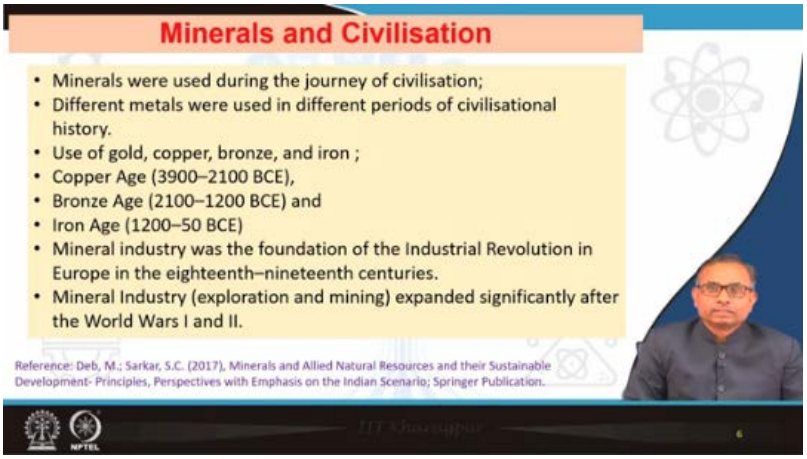
metallic minerals or non-metallic minerals that we are using in our day-to-day life, are very, very important. Now, keeping in mind the importance of minerals in our day-to-day life and the many different types of minerals that we are using for our economic activity, these mineral resources have been classified.

As per the uses, so you can see these mineral resources; they are particularly non-renewable resources, and we have classified them into two broad types: one is the economic and strategic ore deposits, and the second is the industrial rock. So, in the economic and strategic ores, there is further sub-classification: that is, the ferrous metals, then noble metals, and rare metals. Ferrous metals are particularly important because they are used in large quantities: iron, manganese, chromium, tin, nickel, etc. There are some noble metals like gold, silver, and platinum group elements that are used as precious



metals. There are also some rare metals that have very high industrial values. They are used in high-tech industries like tungsten or molybdenum, like that. So, among these economic and strategic minerals, there is a group of minerals like rare earth elements and radioactive minerals; they are of strategic importance because, as you know, nuclear minerals are used for the nuclear industry, and rare earth elements are used for monazite or thorium and other things. So, they have strategic values. And in the non-ore deposits, we have the gemstones, the cement, refractory, fertilizer, ceramic raw materials, fossil fuels, that is, petroleum, natural gas, and like that. In the industrial mineral category or industrial rock category, we have the fossil fuels, that is, coal, lignite, peat; they are also considered as industrial minerals. Although, in the strict geological definition, they may not be minerals, but from a use point of view, from a legal point of view, they are also considered minerals. Similarly, the construction materials, road ballast, or the dimensional stones, building stones, granite, sandstone, marble; they are very useful for building the roads and the houses, and they are also considered minerals. So, the

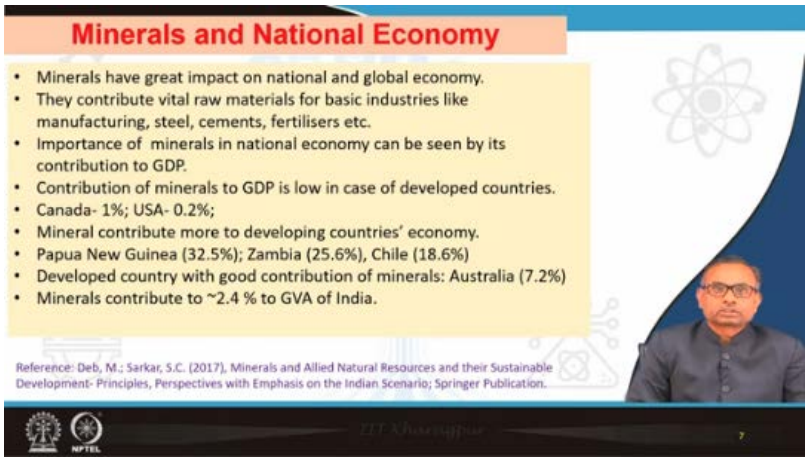
minerals, the use of the minerals, and how they have been our partners in the civilizational journey.



So, we all know that minerals were used during the journey of civilization. Different minerals were used during different periods of the civilizational journey. Long back, people discovered the use of gold, copper, bronze, and iron, and, as you know, there are certain periods of our civilizational history that have been named after the minerals or the metals. For example, the Copper Age, which was 3900 to 2100 years before the Christian era; the Bronze Age, which is 2100 to 1200 years before the Christian era; and the Iron Age, which is 1200 to 50 years before the Christian era. Now, if you come to recent or modern history, that is particularly the Industrial Revolution.

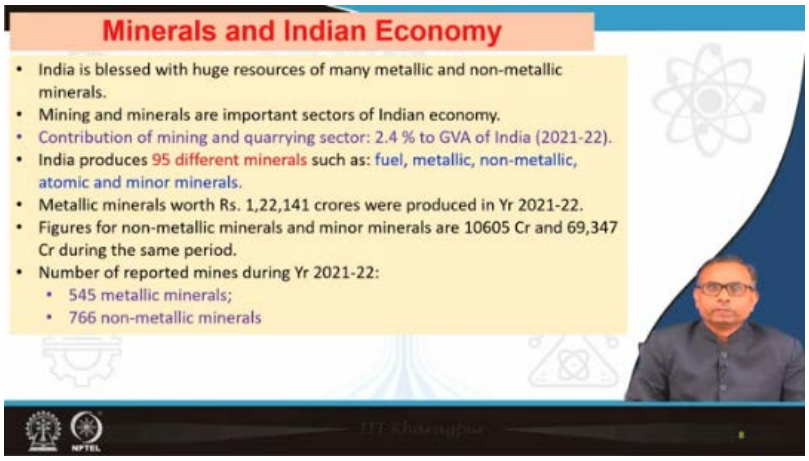
The mineral industry or minerals were the foundation of the industrial revolution, particularly the use of coal and the iron and steel that were the basis of the industrial revolution, which took place in Europe in the 18th to 19th centuries. The mineral industry, particularly the exploration of minerals, the exploitation of minerals, and the development of the mining industry, took a significant stride after World War One and World War Two. So, this is the importance of minerals. Now, we will discuss the minerals and their role in the national economy. Minerals have a great impact on the national and global economy. Particularly, the mineral industry contributes towards the raw materials for many basic industries like manufacturing, steel, cement, fertilizers, etc. The importance of minerals in the national economy can be seen by their contribution to the gross domestic product or GDP of the country.

So, the contribution of minerals to GDP is particularly low for developed countries like the US and other developed countries, but if you look at developing countries, minerals have a strong contribution to the GDP of those countries. Papua New Guinea, for example, has 32.5 percent of its economy contributed by the mineral industry. Similarly, Zambia has 25.6 percent, and Chile has 18.6 percent. So, developed countries have a lesser contribution from the mineral industry because most of their economy comes from the manufacturing and services industries.



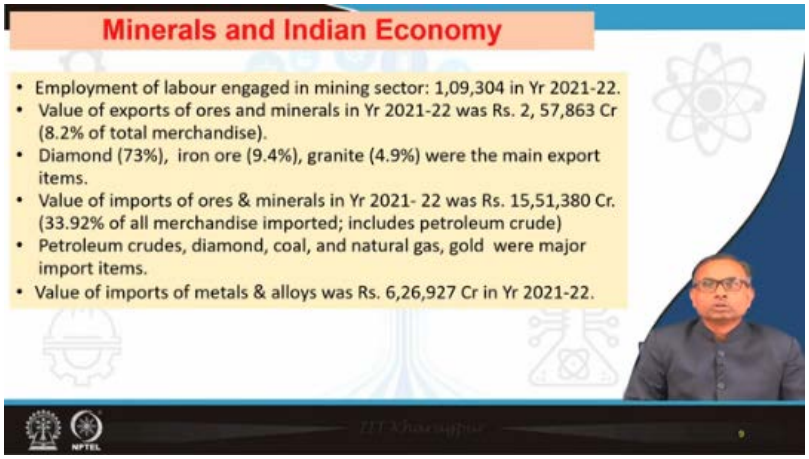
So, for example, Canada has 1 percent of its GDP contributed by the mineral industry, whereas in the USA, it is about 0.2 percent. Among the developed countries, Australia has a good contribution from the mineral industry, with 7.2 percent coming from the mineral industries. For our case, in India, the mineral industry and mining industry contribute about 2.4 percent to the GVA of India. GVA is the gross value added.

It is a new economic indicator as opposed to GDP. So, 2.4 percent of GVA for India is coming from the mining and mineral industry. Now, India is blessed with huge resources of many metallic and non-metallic minerals. Mining and minerals are important sectors



of the Indian economy. As I was telling you, 2.4 percent of GVA of India is coming from the mining and quarrying sector.

It is the data of 2021-2022. India produces 95 different minerals, and among these minerals, we have fuel minerals, metallic, and non-metallic. Atomic minerals and also the minor minerals. Metallic minerals worth rupees 122,141 crores were produced during the financial year 2021-2022, and in the same year, non-metallic minerals worth rupees 10,605 crores were produced during the same year, and minor minerals were produced worth rupees 69,347 crores during the same period. So, you can see what the economy of our mining and mineral sector is. It is a significant part of our economy. Now, among the reported mines, this is the figure of 2021 and 2022. We had 545 metallic minerals and 766 non-metallic minerals. This is the actual number of reported mines: 566 mines for metallic minerals and 766 mines for non-metallic minerals. Now, the mineral sector is a huge employment provider. It employed, for the year 2021-22, the reported labor engaged in the mining sector was 1,09,304. And if you look at the export of ores and minerals in the year 2021-22, it was rupees 2,57,863 crores, which constituted 8.2 percent of the total merchandise exported from our country.



So, mostly Diamond, iron ore, and granite were the major export items. Similarly, if you look at the import of ores and minerals in the year 2021-22, the total value of the imports was rupees 15,51,380 crores. And this constituted 33.92% of all merchandise imported by our country.

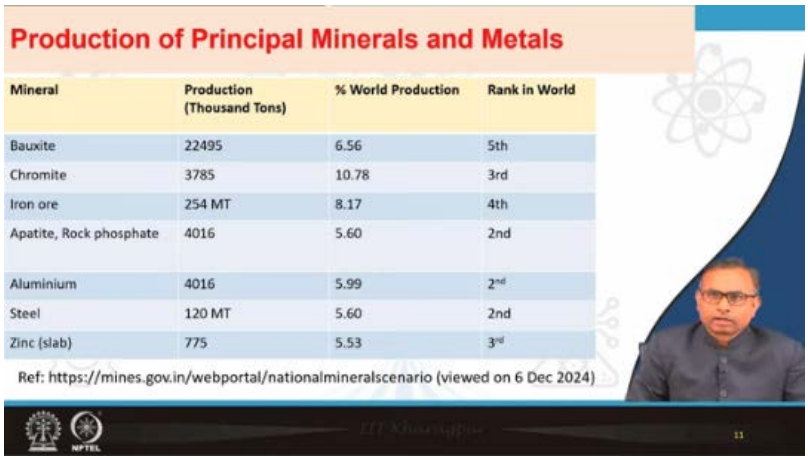
Of course, this huge figure also includes the petroleum crude that we imported. And petroleum crude import was a major chunk of this export. So, for this import item, mostly

petroleum crude, diamonds, coal, natural gas, and gold, they were the major import items. So, if you talk about the value of the imports of metals and alloys, it was rupees 6,26,927 crore in the year 2021 and 22.

So, you can see how this import and export in the mineral sector. So, if you look at the number of mines, I have already told you, if you look at the number of mining leases, you can see this is the figure for 2021. So, we have limestone, for example, with 1960 leases.

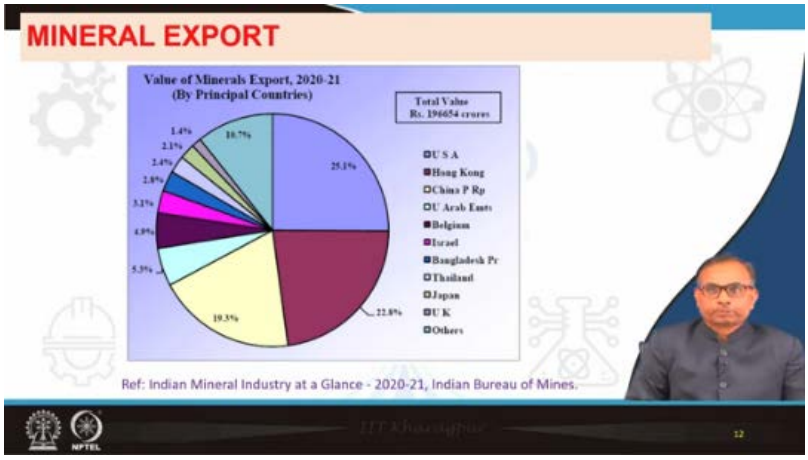
Similarly, significant leases are coming from limestone, iron ore, bauxite, manganese, and the like. And if you look at it, what is the area that is the lakh hectares? You can see that for limestone, it is 1711 lakh hectares. Similarly, the lowest was the chromite, which was 76 lakh hectares.

Now, if we talk about the production of major minerals and metals. So, you can see I have not given a complete list of the different minerals that we are producing that you can. I have already given the reference in the slides, particularly the mineral yearbook published by the Indian Bureau of Mines. There you can see the complete list of the production of different minerals in our country. Still, some of these major minerals that we are producing or major metals that we are producing in our country, we have listed just you can make an appreciation of this about the minerals.



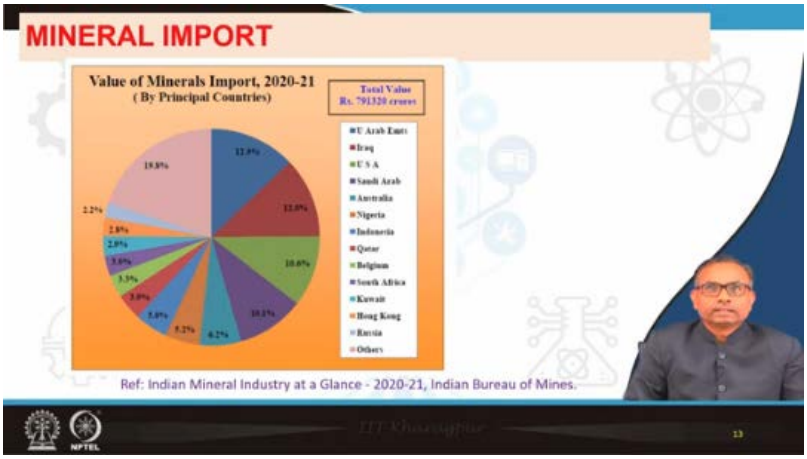
For example, bauxite is the figure for, I think, 2022-23. So, production is in thousand tons, 22,495 tons, and this bauxite production in India is 6.56 percent of the world's production, and we are ranked fifth in the whole world. Similarly, this iron ore, for example, we are producing about 254 million metric tons of iron ore, which is actually 8.17 percent of world production, and in iron ore production, we are fourth in the world. Similarly, the chromite, we are producing 3,785,000 tons, which is 10.78 percent of world production, and we are ranked fourth in the world in chromite production. Similarly, if you look at the metals, we are producing 4,016,000 tons of aluminum. which is 5.99 percent of world production, and we are second in aluminum production. Steel, we are producing 120 million tons of steel, which is 5.6 percent of world production, and we are second in the world production after China. Similarly, zinc slab, we are producing 775,000 tons, which is 5.53 percent of world production, and we are third in the world in zinc production.

So, this is the graph or pie chart that shows the value of mineral exports.



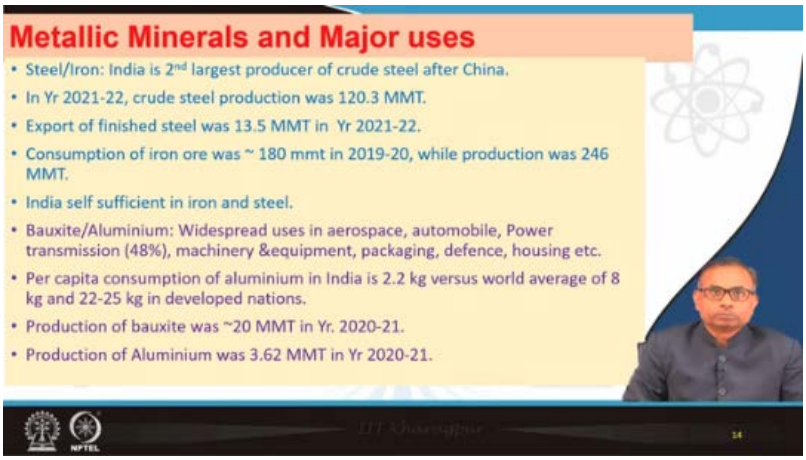
What are the different minerals? What are the minerals we are exporting to different countries? So, this is for the year 2020-2021, and in the year 2020-2021, we have exported minerals worth rupees 19 lakh 6,654 crores of minerals, and you can see among the different countries that we are exporting, mostly the USA is the major buyer of our minerals that we are exporting.

Similarly, we are importing a huge quantity of minerals, for example, in the year 2020-21, we imported 7,91,320 crores worth of minerals, and actually, this figure also includes petroleum crude.



So, you can see that a large production, 19.8 percent, is coming from Saudi Arabia and other countries. So, we are importing petroleum crude, coal, gold, and others.

So, we will now talk about some metallic minerals and their major uses. So, steel, or we say iron. So, India is the second-largest producer of crude steel after China, and to produce steel, you require iron ore. we are self-sufficient in iron ore, and we have a huge reserve of iron in our country. In 2021-22, crude steel production was 120 million metric tons, and finished steel exports were 13.5 million metric tons. During the same year, we

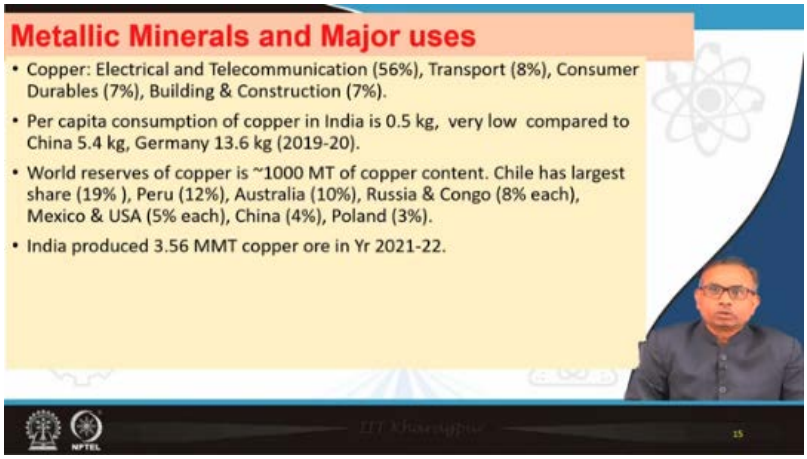


consumed a huge quantity of iron ore, for example, about 120 to 200 million metric tons of iron ore was consumed during 2019-2020, and the production of iron ore during 2019-20 was 246 million metric tons because the iron ore that we are producing, we are consuming for domestic steel production, and we are also exporting some of the iron ores to other countries like China and others. India is self-sufficient in iron and steel, and we all know the utility of steel. It is used in various sectors, so it is unnecessary to explain it.

We all appreciate it. Now, one of the major minerals that are very important is aluminum, and aluminum is produced from bauxite.

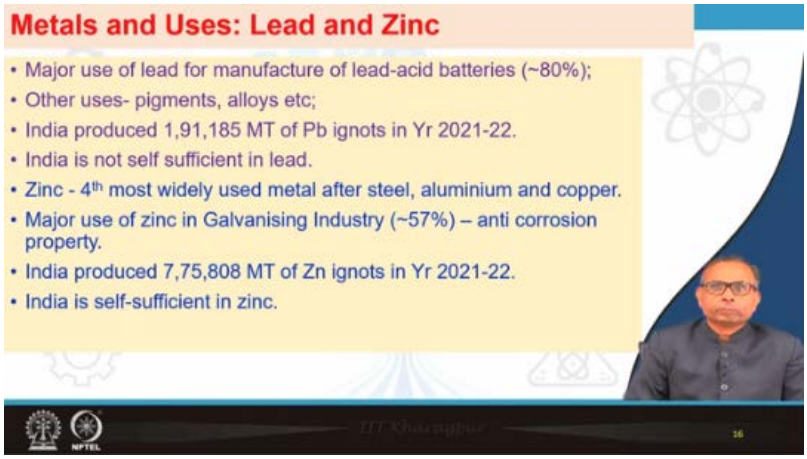
So, aluminum has widespread use in aerospace, automobile, power transmission, machinery and equipment, packaging, defense, house building, etc. Now, the per capita consumption of aluminum in India is 2.2 kg versus the world average of 8 kg, and in developed nations, the per capita consumption of aluminum is 22 to 25 kg. That means we have a long way to go, and we require a huge quantity of bauxite. Now, the production of bauxite in the year 2020-21 was 20 million metric tons, and the production of aluminum in the same period was 3.62 million metric tons.

Another important ore is copper. We all know how useful copper is for the electrical industries and other applications. The electrical and telecommunication industry has a lot of uses. In the transport sector, particularly in EVs, copper is used. In consumer durables, the electronic sector, and building and construction, copper is used.



Now, the per capita consumption of copper in India is 0.5 kg. This is very low compared to China, which consumes 5.4 kg per capita. And if you compare it with developed European nations like Germany, their per capita consumption of copper is 13.6 kg. So, we have a long way to go to catch up with the average world or the developed countries. Now, the world's reserves of copper contain about 1000 million tons of copper.

Chile has the largest share, about 19 percent; Peru, 12 percent; Australia, 10 percent; Russia and Congo, 8 percent; Mexico and the USA, 5 percent; China, 4 percent; and Poland, 3 percent. In India, our copper production and reserves are very low compared to other countries. Production is also low. So, India produced 3.56 million metric tons of copper ore in the year 21-22. Other important metallic ores are lead and zinc.



The major use of lead is for the manufacturing of lead-acid batteries. Most of the lead is consumed by lead-acid batteries, which account for 80 percent, and there are other uses like pigments and alloy making where lead is also used. Now, India produced about 1,91,185 metric tons of lead ingots in the year 2021-22. India is not self-sufficient in lead.

So, we are critically dependent on other countries for our requirement of lead. Now, the associated minerals or associated metals include zinc. Zinc is the fourth most widely used metal after iron, aluminum, and copper. The major use of zinc is in the galvanizing industry because zinc has anti-corrosion properties. So, in the steel industry, it is used for galvanizing. So, 57 percent of the zinc used is by the galvanizing industry. India produced 7,75,808 metric tons of zinc ingots in 2021-22. India is self-sufficient in zinc metal.

Now, among other precious metals, particularly gold and silver, they are precious metals, and we have a strong demand for gold and silver in our country because, you know, we consume a lot of gold and silver as jewelry.

It is our socio-cultural requirement that we require a lot of gold and metal. Now, India produces 7,387 kg of gold in the year 2021-22, and as you might know, India is not self-sufficient in gold, and we import gold from other countries. Similarly, India produced 7,57,96 kilograms of silver in the year 2021, and silver also has its use in terms of jewelry and other industrial uses.

So, this is the summary or conclusion of today's class. Thus, today's lecture session covered the following topics: we discussed the role of minerals and mining in society and the national economy. We have discussed the journey of minerals and metals through

civilization, how civilization was named after copper, bronze, and iron, and all that because of the importance of these metallic minerals. We classified the minerals as per our uses.

We also discussed the different metallic minerals. Today, we discussed the different metallic minerals and what is our position in India in the production and consumption of these metallic minerals. We will continue this class in the next class, and there we will talk about other non-metallic minerals, rare earth element minerals, and other critical minerals that are very useful for our economy. Also, this reference slide I have shown

you, I hope this lecture will be useful for you. So, you can see the reference. I have given the references; you can go to the references and get more information about the minerals.

So, we stop here for today, and I will continue this topic in the next class, and we will discuss the non-metallic and other minerals that are very important for our society and our economy. Thank you very much.