Surface Mining Technology
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Lecture No. 02
Current Status of Surface Mining

Let me welcome you to the second lecture of Surface Mining Technology, we are continuing to our introduction to surface mining, and the title of this lecture is the Current Status of Surface Mining. In the last class, we have started with the rock and rock mass characteristics.

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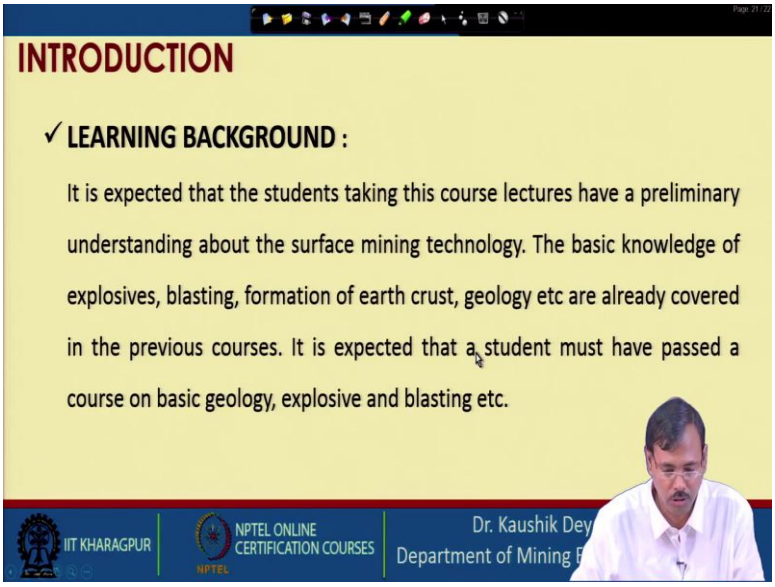

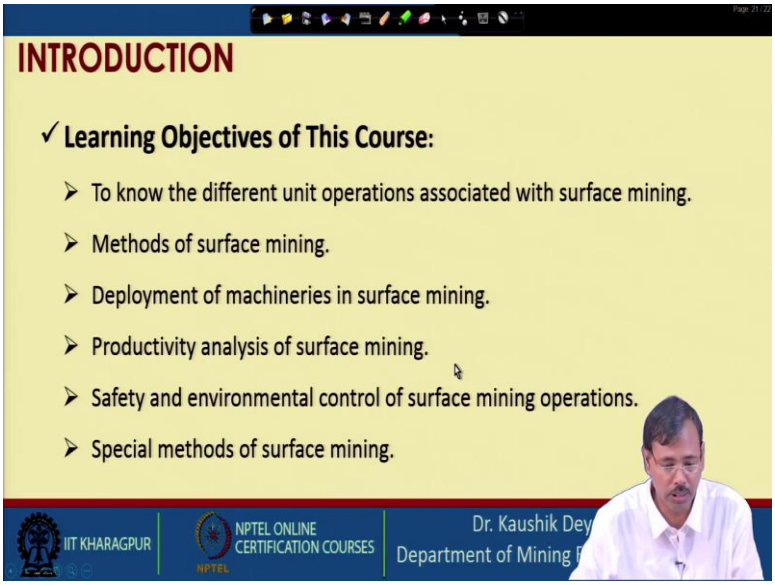

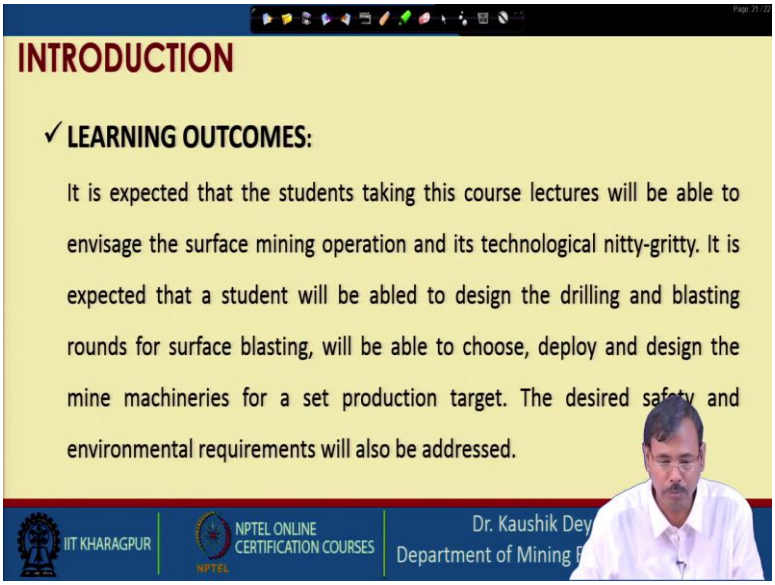

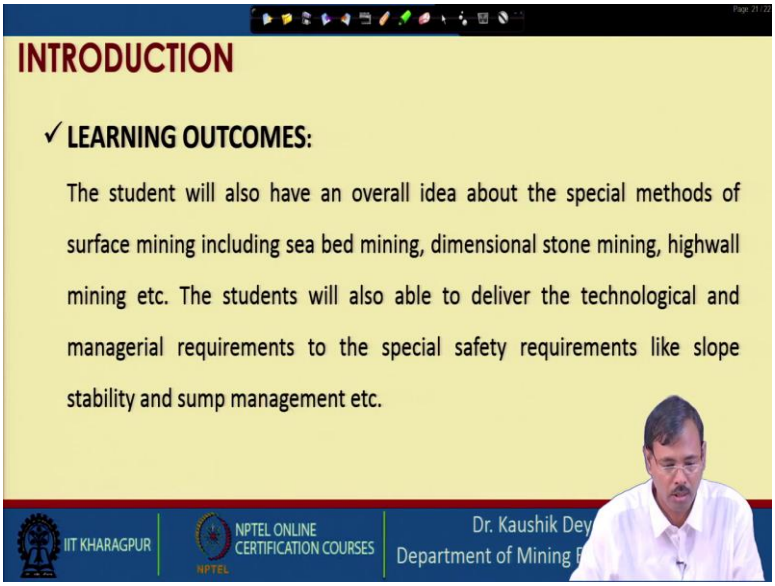

This part is already discussed with you, and this is the learning background of the course. Then learning objective of this course and then learning outcomes of the course Surface Mining Technology.

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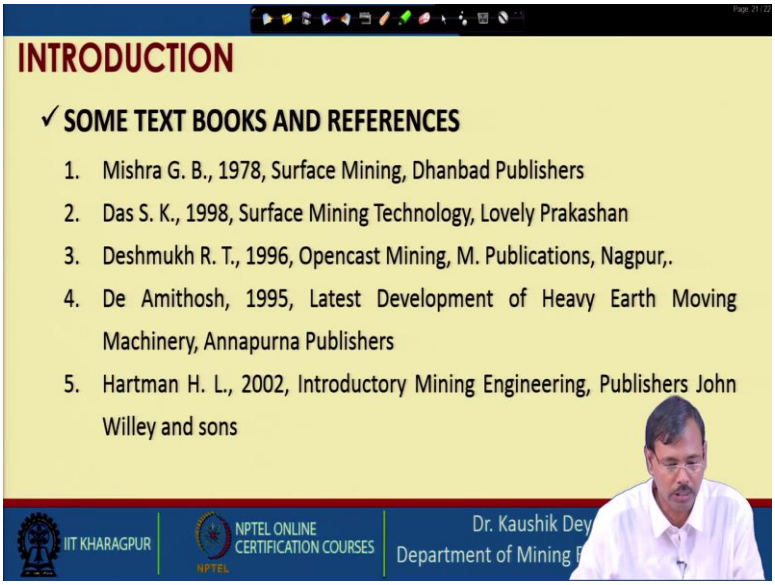

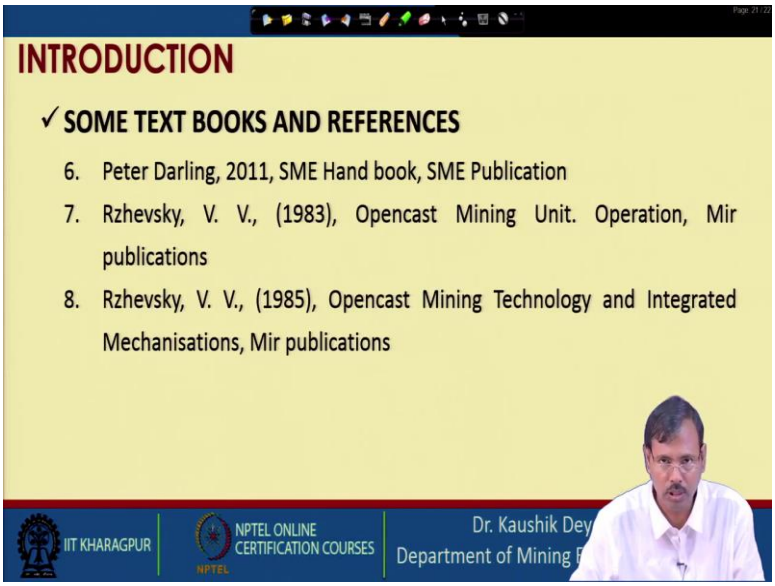

These are the different textbooks and different reference books that you can see for the Surface Mining technology.

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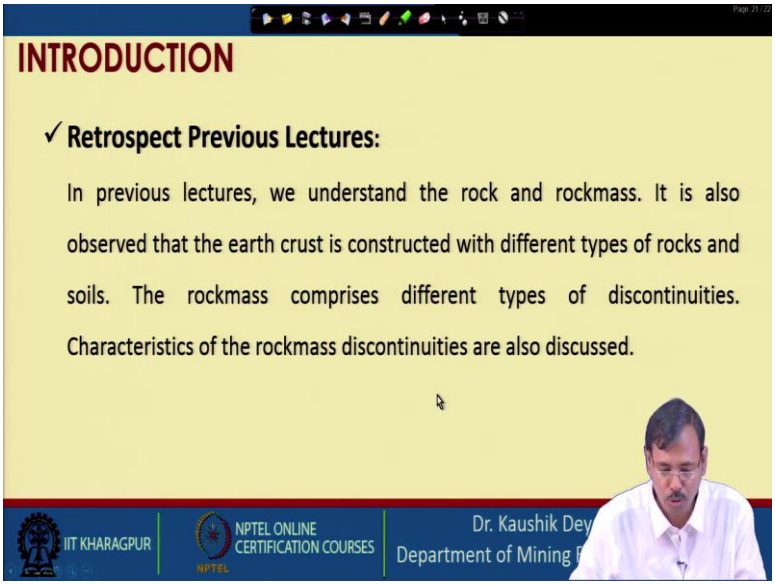

Let us retrospect the previous lecture. We understand the rock and rock mass. It is also observed that the earth's crust is constructed with several types of rocks and soils. The rock mass comprises diverse types of discontinuities, characteristics of the rock mass discontinuities are also discussed in the previous lecture.

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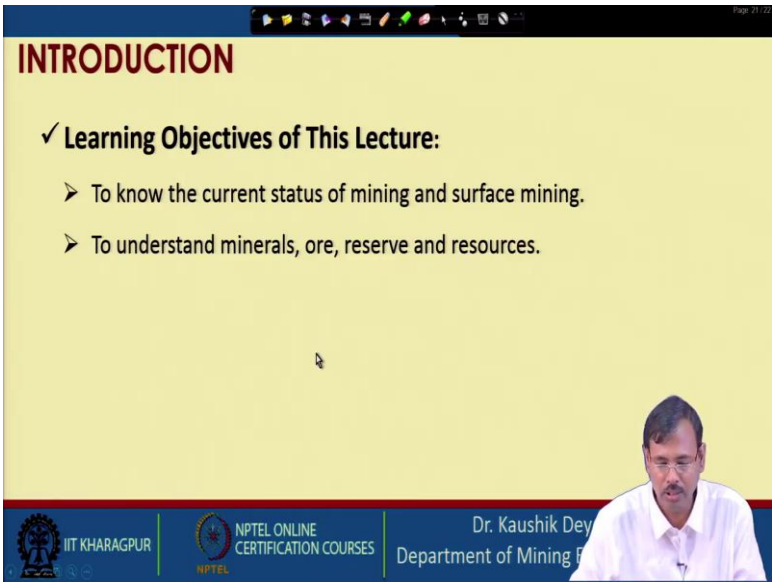

So, this lecture will start with an introduction to surface mining. To know the current status of the mining and Surface Mining over the globe, over the country, and last class which we could not cover, that is the understanding of the mineral ore reserve and the resource. So, at the very beginning, this part we will cover first, the understanding mineral ore reserve and resources.

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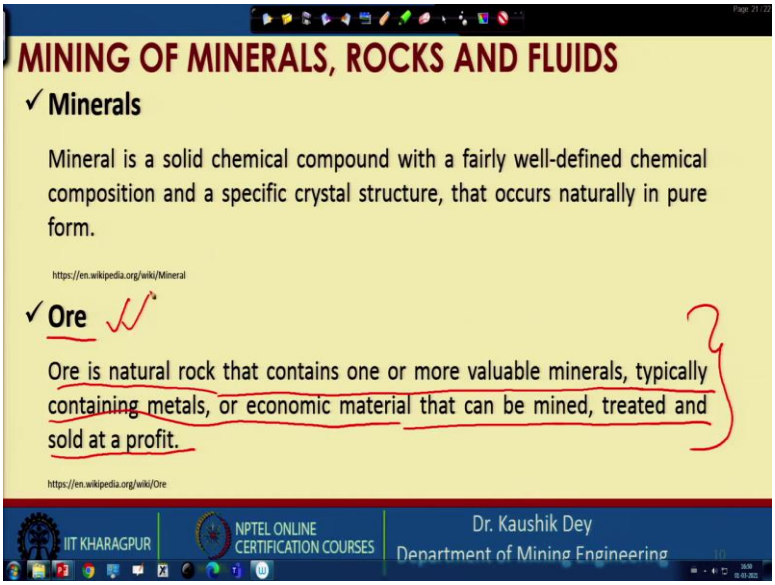

So, a mineral is basically a solid chemical compound with fairly well-defined chemical composition and a specific crystal structure that occurs naturally in pure form. So, in the last class, we have discussed that rocks are basically a composition of a number of minerals. So, minerals have their definite crystal structures, they have their definite chemical properties, and a number of minerals are joined together to form a rock.

Now, as minerals have the oil defined chemical compositions, that means, in some of the minerals, we may have an interest. But, if the mineral is interesting, then also it is may not be possible that we can go for mining of the mineral. The reason is that in a mineral, it may be possible the mineral is very, very interesting, but we cannot mine out the mineral. We have to mine out the rock, and what is happening in the rock may be the composition of the mineral is not significant enough so that we can go for mining it economically.

So, minerals are good; it may be of our interest, but a mineral does not tell us that you will go for mining of the same. We will go for mining of the mineral only when the composition of the mineral or the occurrence of the mineral in the rock is of interest and should be excavated economically. So, in that case, that mineral is called ore.

So, basically, the ore is a natural rock that contains one or more valuable minerals, typically containing metals or economic materials that can be mined, treated and sold at a profit. So, if the material is such that excavation of the same fetches a profit to the organisation, then only that can be mined and when that is mined, that is called ore.

That means, in other words, you can say when the mineral is mined, that is called ore. So, you can also say that when the mineral is found, that is profitable to be mined. In that case, that mineral is called ore. I think now it is clear to you the difference between the mineral and the ore.

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Now let us look into the different types of minerals. There are different holistic minerals that are given here. But I would like to draw your attention to this part. What is this? CuFeS2 is termed as the chalcopyrite. I think there is also it is given somewhere this is chalcopyrite. The next one is given CuCO3 Cu(OH)2. This is a composition of these two called malachite, and I think it is given here somewhere.

So, this chalcopyrite and malachite. Both of these minerals are basically the ore of copper which means both of these are ore of copper. Now, ore of copper means, if we carry out mining of chalcopyrite, if you carry out mining of malachite from both the minerals, you can extract copper, and this extraction technology is known to us. So, technology is known to us, and the technology is economical, which means we can fetch some profit.

So, if we have a chalcopyrite deposit if we have some malachite in both the cases if we extract that if we process that refines that we can extract a copper metal out of this and that can be carried out profitably. So, this is basically showing us that minerals may be different, but both can be treated as copper ore because both of them are profitable to us.

So, similarly, you can find out n number of other examples are there, like say hematite, and you can say pyrite. So, what is happening in hematite, in hematite, it is basically oxides of iron, and this is sulphide, iron sulphides. So, these oxides and sulphides this is not in general use to extract the iron from the pyrite because the process is much easier and profitable in the case of oxide.

So, that is why pyrite, though iron is available in the pyrite, in general, we do not go for extracting iron from the pyrite. So, there are many examples like this in general. In most

cases, we found that these minerals metals, these metals and maybe some other cases non-metals are available, either in sulphide form or in sulphate form or in carbonate form or oxides from, these are the most common formation of the minerals from which in general we go for extraction of the metals or non-metals.

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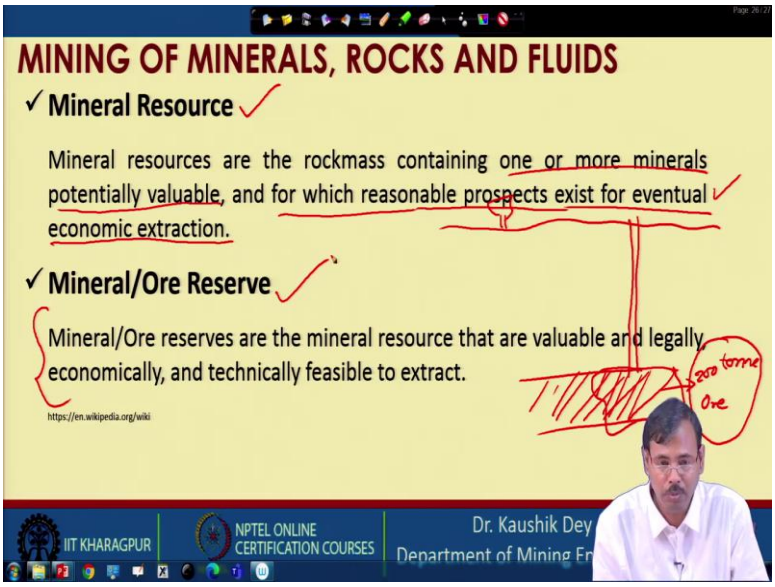

A mineral resource is the rock mass containing rock mass containing one or more minerals potentially valuable and for which reasonable prospects exist or eventually economic, for economic extractions. This is what is the meaning of this. Suppose this is the earth crust and below this earth crust at this place, say suppose you are having 200 tonnes of some, 200 tonnes of some course, but can it be possible to go for economical mining.

The reason is that you have to take out all these materials or only 200 ores. If you are taking this trouble to excavate this one, exploit this one. This may not be profitable. So, the occurrence of the ore does not guarantee that it can be, it can be excavated economically. But, the chances if it is expected that there is a likely chance that this can be excavated economically, then it is called mineral resource.

That means, today it may not be, we know that occurrence we are sure about the occurrence of this one, but we are not sure about the eventual economic extraction of the same it may be potentially valuable in the future, in that cases is called mineral resource. But when the mineral resource is valuable and legally, economically and technically feasible, then it is called reserve.

So, the basic idea or in one word, if you would like to tell that the mineral reserve is that ore reserve is that for which we are sure that we can exploit it economically, the exploitation technology is also available with us, and that can give us a good profit then that is called result.

But, if we know or we are a little bit sure about the occurrence of the deposit, but we are not sure about its economic exploitation, or it may be because of the technical problems, it may be because of the socio-economic problems, then it is called resource, not the reserve. So, a reserve means we know everything, and we are just going to exploit that; that is called reserve.

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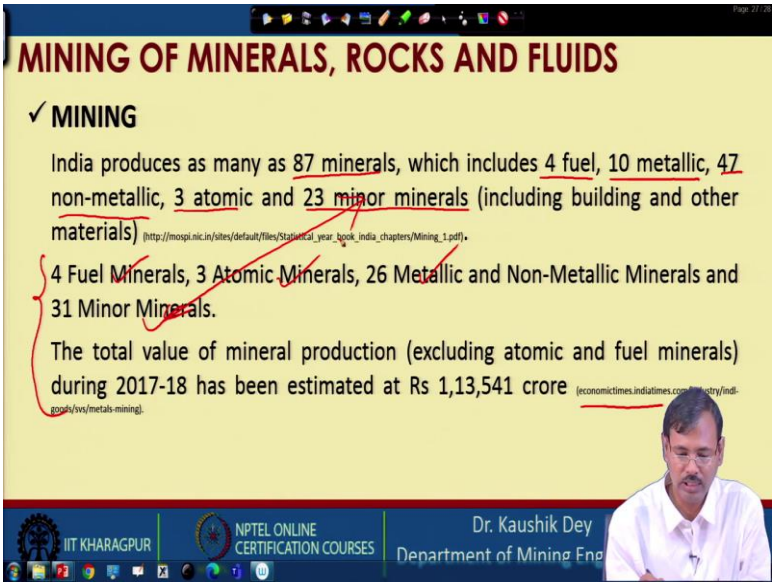

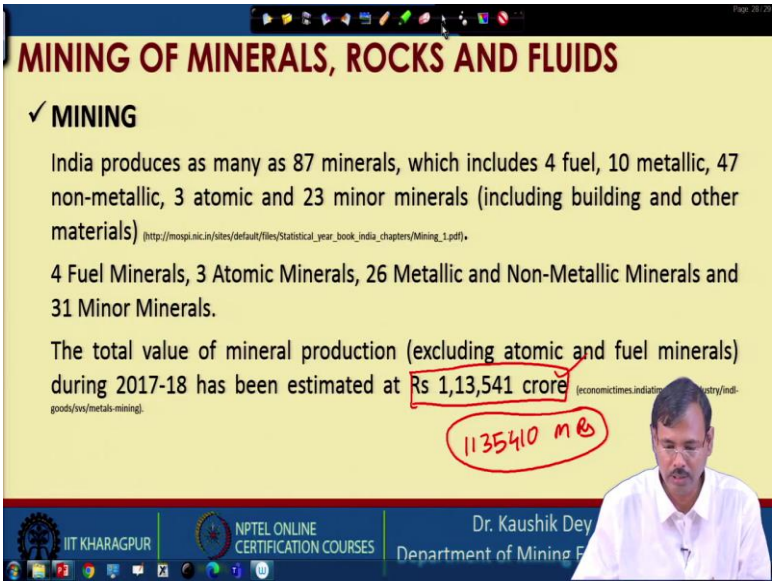

Now, let us look into the scenario for our national scenario, for the mining of minerals and ores. India is mining 87 minerals, which includes 4 full minerals, 10 metallic minerals, 47 non-metallic minerals, 3 atomic minerals and 23 minor minerals. These values are altered in some other sources, I have found this source that is economic times, this is an dot nic dot in site, this is telling this value, this economic time is telling 4 fuel minerals, 3 atomic minerals are 26 metallic, non-metallic minerals and 31 minor minerals.

So, there is a change in the part of this minor mineral significantly there is a change in that. So, this is the number of minerals currently India is exploiting, and you can see the total value of the mineral production. The total value of mineral production is 1135410 million rupees. So, this is in crores, this is million rupees. So, that means it is significantly higher and contributes to the country's economy.

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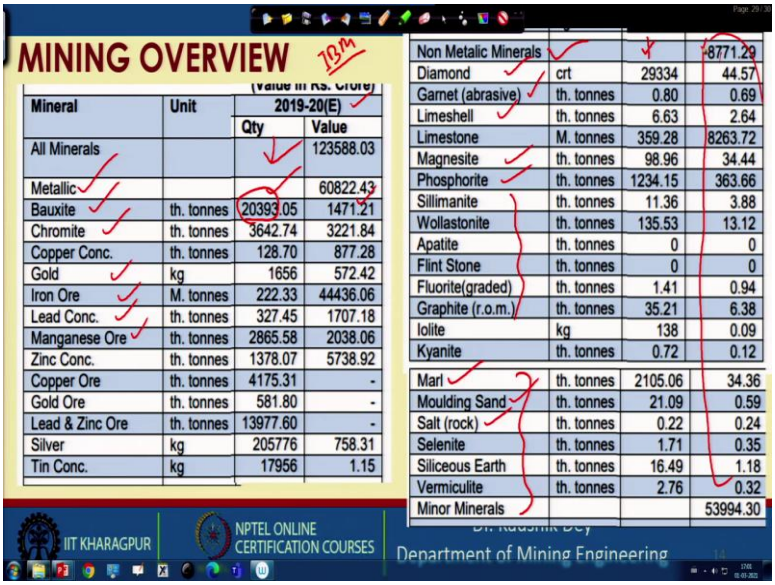

And let us now look into the current status. These values are available in Indian bureau of mines website, IBM website these values are available. So, this is 2019-20 estimated values. So, you can see different minerals, bauxite is basically the ore of the aluminium, chromite, gold iron, lead manganese-all these are you can see this is how much quantity it is being produced.

So, this 1000 tonne is expressed, and its values are given at this point. So, by this way, if you see, these are the metallic minerals, these are the non-metallic minerals, which includes diamond, garnet, limestone, magnasites, phosphorite and all others, including graphite kyanite and these are the minor minerals, some of the minor minerals are expressed here. Marl, moulding sand, salt.

So, these are the minor minerals and total production. These are given here in this column, total production, and this is the value of the production is expressed here. So, you can see this is in rupees crore. So, this is a total of two rupees crore. How much the excavation is how much mineral is excavated here is basically explained in this figure.

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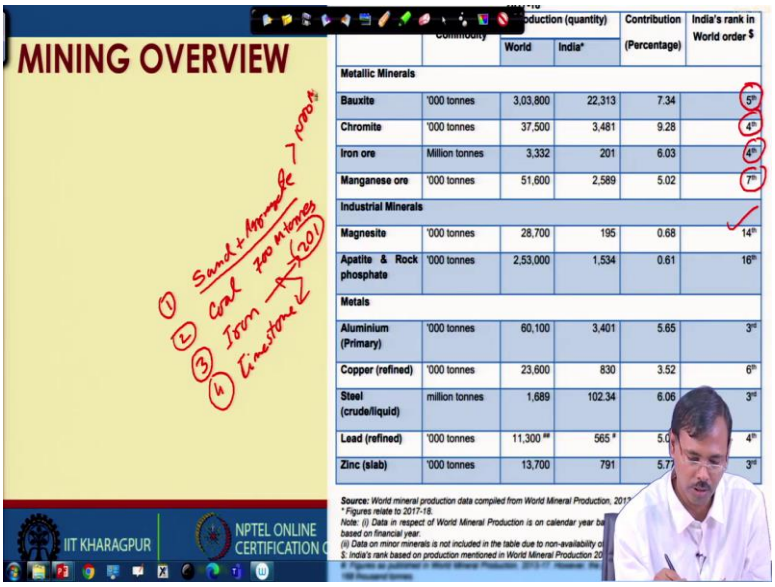

Commodity		Production (quantity) World	Production (quantity) India*	Contribution (Percentage)	India's rank in World order $
Metallic Minerals					
Bauxite	'000 tonnes	3,03,800	22,313	7.34	5th
Chromite	'000 tonnes	37,500	3,481	9.28	4th
Iron ore	Million tonnes	3,332	201	6.03	4th
Manganese ore	'000 tonnes	51,600	2,589	5.02	7th
Industrial Minerals					
Magnesite	'000 tonnes	28,700	195	0.68	14th
Apatite & Rock phosphate	'000 tonnes	2,53,000	1,534	0.61	16th
Metals					
Aluminium (Primary)	'000 tonnes	60,100	3,401	5.65	3rd
Copper (refined)	'000 tonnes	23,600	830	3.52	6th
Steel (crude/liquid)	million tonnes	1,689	102.34	6.06	3rd
Lead (refined)	'000 tonnes	11,300 ##	565 #	5.0	4th
Zinc (slab)	'000 tonnes	13,700	791	5.7	3rd

So, if you look into this, India is not far behind, and international standards are shown here. So, if you are considering India stand fifth for bauxite, fourth for chromite, fourth for the iron ore, seven for the manganese ore, and these are the different industrial minerals, and this is metal wise different poisons are given.

Now, if you see our maximum production, if you look into this, the maximum production obviously in India, we are having the aggregate stone sand and aggregate, sand and aggregate. This is ranked one production wise almost 1 billion tonnes more than 1 billion tonnes of sands and aggregates are produced every year. The next mineral which is produced is coal, which is a full mineral approximately 700 million tonne of coal is being produced.

Third iron ore, limestone. This is more or less ranking you can see it is almost 300, almost 200 million tonne we are producing iron ore, 200 million tonne of iron ore are being produced every year. So, this is the ranking country India's production of the different minerals produced in India. This is almost done 1000 million tonnes.

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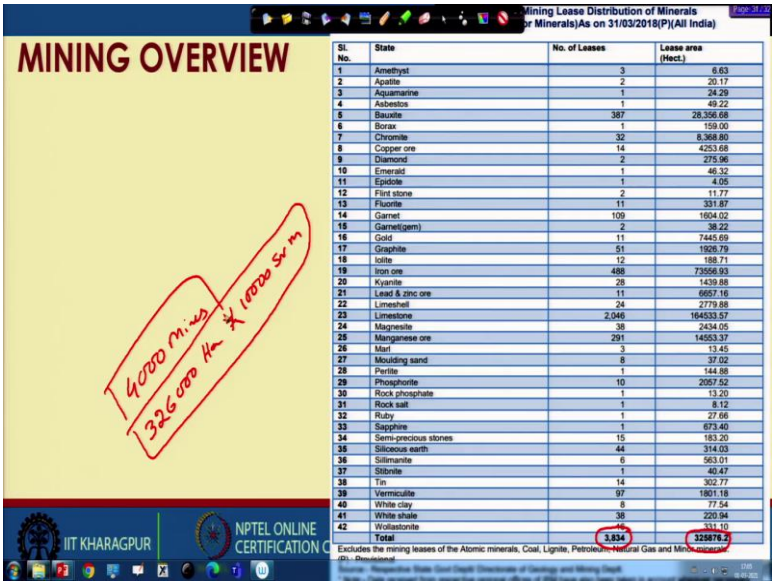

Sl. No.	State	No. of Leases	Lease area (Hect.)
1	Amethyst	3	6.63
2	Apatite	2	20.17
3	Aquamarine	1	24.29
4	Asbestos	1	49.22
5	Bauxite	387	28,356.68
6	Borax	1	159.00
7	Chromite	32	8,368.80
8	Copper ore	14	4253.68
9	Diamond	2	275.96
10	Emerald	1	46.32
11	Epidote	1	4.05
12	Flint stone	2	11.77
13	Fluorite	11	331.87
14	Garnet	109	1604.02
15	Garnet(gem)	2	38.22
16	Gold	11	7445.69
17	Graphite	51	1926.79
18	Iolite	12	188.71
19	Iron ore	488	73556.93
20	Kyanite	28	1439.88
21	Lead & zinc ore	11	6657.16
22	Limeshell	24	2779.88
23	Limestone	2,046	164533.57
24	Magnesite	38	2434.05
25	Manganese ore	291	14553.37
26	Marl	3	13.45
27	Moulding sand	8	37.02
28	Perlite	1	144.88
29	Phosphorite	10	2057.52
30	Rock phosphate	1	13.20
31	Rock salt	1	8.12
32	Ruby	1	27.66
33	Sapphire	1	673.40
34	Semi-precious stones	15	183.20
35	Siliceous earth	44	314.03
36	Sillimanite	6	563.01
37	Stibnite	1	40.47
38	Tin	14	302.77
39	Vermiculite	97	1801.18
40	White clay	8	77.54
41	White shale	38	220.94
42	Wollastonite	45	331.10
	Total	3,834	325876.2

Excludes the mining leases of the Atomic minerals, Coal, Lignite, Petroleum, Natural Gas and Minor minerals
(P) - Provisional

If, now if you look into the leasehold area, if you are looking into the leasehold area, you will find out the total leasehold area is, total leasehold area is 325,000 hectare and this is the number of the lease, this was in India around 4000, around 4000 mines are under operations. These 4000 mines are approximately 326,000 hectares, 1 hectare means 10,000 square metres. So, this much of area, this much of area is occupied by these mines.

So, this shows that the volume of mining is carried out in the country, and we have already observed that the economic impact of mining in the country is already observed.

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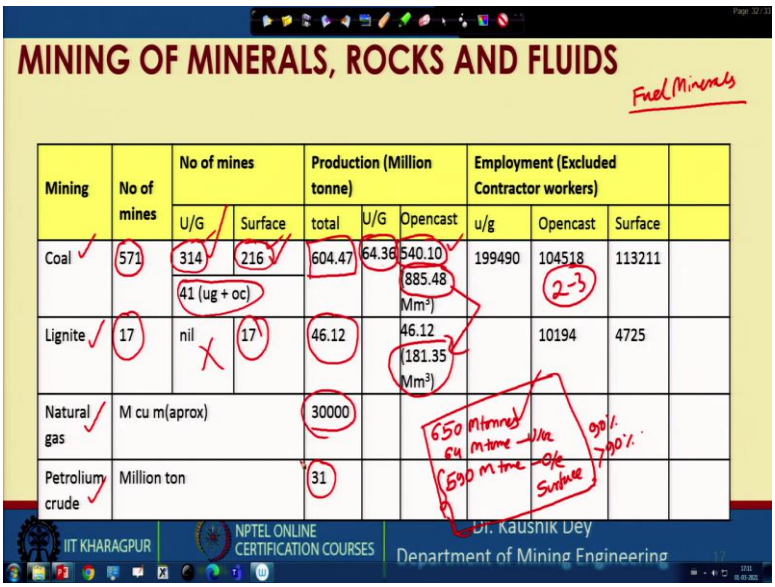
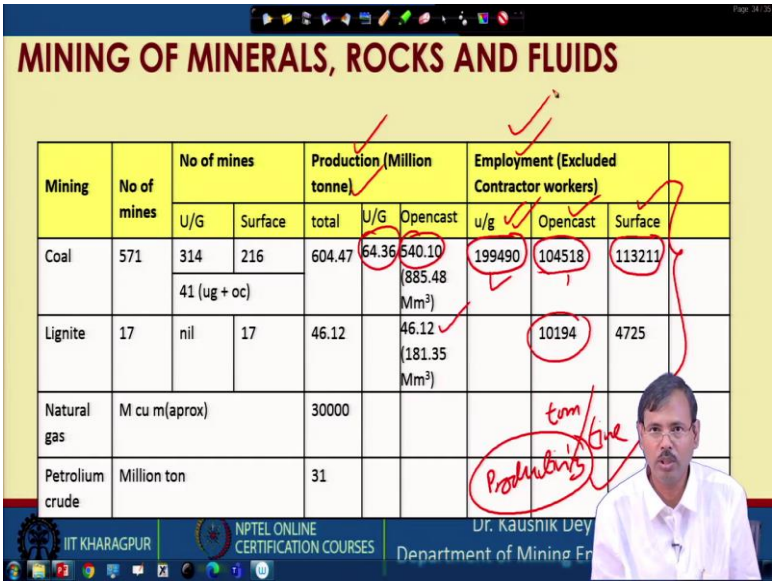


Mining	No of mines	No of mines		Production (Million tonne)			Employment (Excluded Contractor workers)			
		U/G	Surface	total	U/G	Opencast	u/g	Opencast	Surface	
Coal	571	314	216	604.47	64.36	540.10	199490	104518	113211	
		41 (ug + oc)				885.48 Mm³)		2-3		
Lignite	17	nil	17	46.12		46.12 (181.35 Mm³)		10194	4725	
Natural gas	M cu m(aprox)			30000						
Petrolium crude	Million ton			31						

650 M tonnes 64 m tone U/g 590 m tone O/c Surface 90% 7 90%



Now, let us look into the coal mining of the country, this is related to only the fuel minerals. We have four fuel minerals, and the major is coal, lignite, natural gas and crude petroleum. The coal we have 571 mines under operations, in the underground, we have 314 mines, 216 mines are there, which are operating in the surface and there are 41 mines which are operating both in underground and open cast mines.

So, this 41 is included here also in this place. So, there are a total number of coal mines says this, the total million-ton production, coal production is 604 million tonnes from underground the production is 64 million tonnes, for the open cast production is 540 million tonnes and while the opencast mining is carried out, obviously, the west rock which is covering the coal, that rock has to be handled and this is the 885 million metre cube of overburden are also being handled for this opencast coal mines.

So, now, from here I draw your attention that 314 underground mines are producing only 64 million ton, whereas 216 surface mine is producing 540 million tonne that means, on average 2.5 million tonnes are being produced by each surface mine, whereas the average underground mines are producing only point 0.2 million ton that means, 2 lakh tonne of coal is being produced from the underground mines.

We are also having 17 lignite mines. In these 17 lignite mines, we are also getting at a similar rate of 46 million tons, which means, again, that 2.5 million tons per mine, we are also observed here. All these lignite mines are surface mines, there is no underground mined available for the lignite mines, and while these lignite mines are producing 46 million tonnes of lignite simultaneously, they are also handling 181 million metre cubes of overburden.

So, that means only if you are considering coal mining, we are almost 650 million tonnes of coal are being produced and only 64 million tonne is from underground and almost 590 million tonne are really strong opencast and that is why you can see, opencast mines means surface mine, you can understand why this surface mining technology is very, very important.

So, surface mining technology is basically producing the majority of the production that means, almost 90 percent of the coal is being produced from this and more than 90 percent of the material is also produced from the non-coal sector, which means the metallic non-metallic mines are also producing.

So, amongst if you are considering total mining production in the country, more than 90 per cent of the whole production comes from surface mining only. You can understand that is why the surface mining technology is basically the main mining technology that governs the country's economy.

And you can see, while we are producing this much of our required material simultaneously, we are also handling this much quantity of the overburden rocks also. So, the excavation has to be carried out for almost 2 times or 2 to 3 times of the production being carried out in the mind. So, that is why you can see, this volumes are very, very high and that excavation has to be planned has to be practised in the mine.

We are also having some production of natural gas. This 30,000 million metre cube is almost natural gas is being produced, that is through the well, drilled oil and petroleum crude petroleum are also produced around 31 million tonnes from our different oil, crude oil mining whether that it is in Bombay high or in the Assam field in from different petroleum mining sectors, it is being excavated.

Now, let us look into the employment status how much employment is being generated by surface mining. This is carried out only for fear of cold sectors, other sectors that could not be collected, you can see the manpower deployed for the underground is this much say almost two lakhs, you can say, for the open cast, it is half of that, almost half of that and it is surface.

Now, let me define the surface. Surface means these are the mining workers who are carrying out mining. Surface workers mean the office people, those in the surface for underground the timekeeper for the safety people or for the plant people, those who are working in the surface, this is the considerations of that only or the managing people these are considering in the surface.

So, this is the employment you can see almost double employment is there for this small production, but with the half of that, this much is being produced that means, surface mining, it requires less manpower, but it generates very high, and this is also a very, very important aspect for the surface mining technology.

In lignite, you can see only 10,000 people are deployed and that is giving 46 million tonne of lignite. So, this is very, very important. So, basically, surface mining technology is machine-driven. High mechanisation is observed in these cases. That is why you can find out the production rate is much, much higher with a little bit of manpower deployment. That means, production rate means the material produce tonne produce with the particular specified time maybe hour or maybe a day, maybe year, production per year. So, this is production per year.

Now, the second term, I would like to introduce to you that is called productivity, productivity depends on the production rate you have achieved per unit employment. So, the production rate you are achieving per unit employment, that is, productivity, is also very high in surface mining technology. So, surface mining, you have high production rate, you have high productivity, and that is why surface mining is a very popular mining system in the, not only in the country in the worldwide.

So, surface mining is very, very popular. We can see its economic, we can see its economic effect onto the country's economic countries growth, surface mining technology, that is why is considered as the prime technology or the need of the time for the growth of the country.

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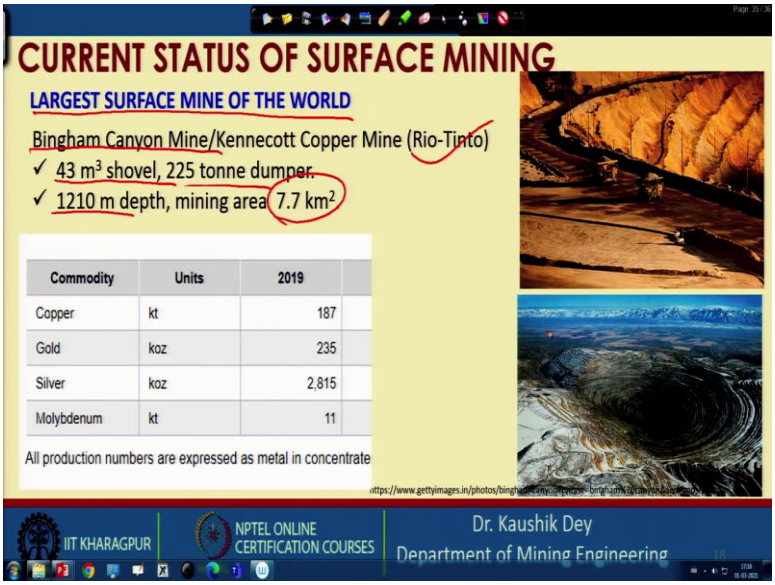

So, let us see some of the important or some of the notable mines. This is the first mines. This is the largest surface mine available in the world. This is Bimgham Canyon Mine currently owned by the Rio-Tinto, this mine is operating at 1200 metre depth. It is using 43 cubic metre shovel 225 tonne dumper and the leasehold area is 7.7 square kilometres. So, this is the photograph of the mine, you can see the operations of the mind. This is the deep most mine of the world, surface mine of the world.

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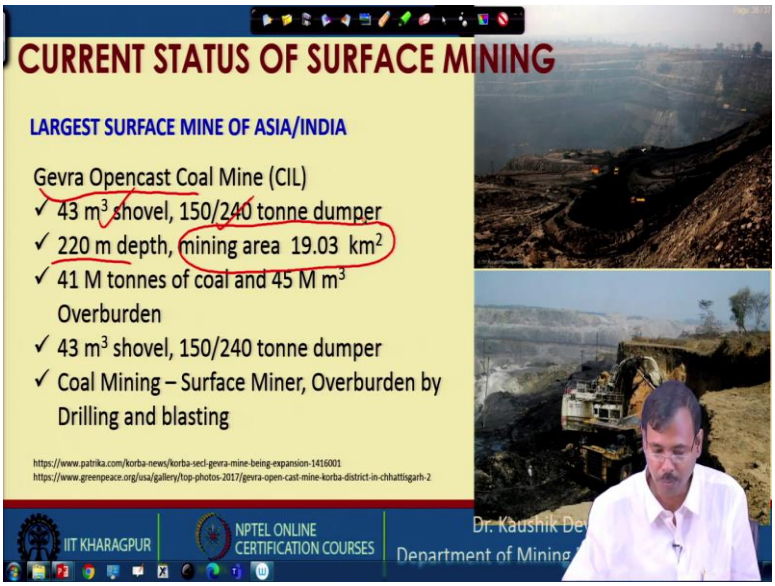

If you are considering the Indian context, then Gevra is the largest mine. Gevra is the largest opencast coal mine, which is also working with 43 cubic metres shovel 150 tonne or dumper and its correct operating depth is 220 metre only, but you see the leasehold area is much,

much higher than that Bimgham copper mines, 19 square kilometre is the leasehold area. So, this is very, very big mine in fact, this is the largest mine of the Asia also and you can understand its yearly production is 43 million tonne of coals are being produced by this.

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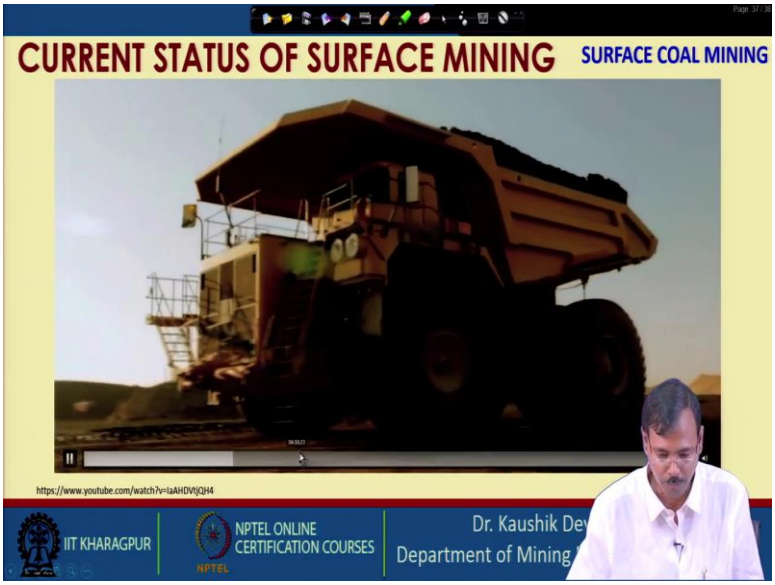
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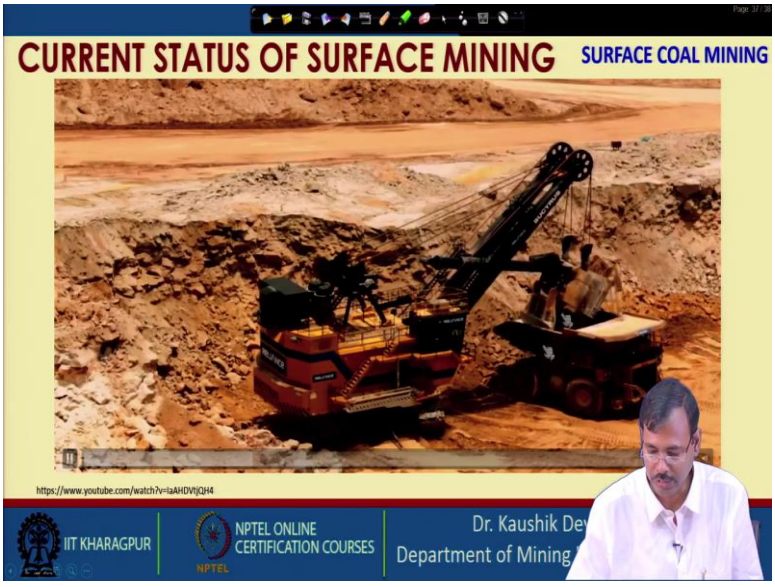
CURRENT STATUS OF SURFACE MINING
SURFACE COAL MINING
https://www.youtube.com/watch?v=IaAHDVtjQH4
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NPTEL ONLINE CERTIFICATION COURSES
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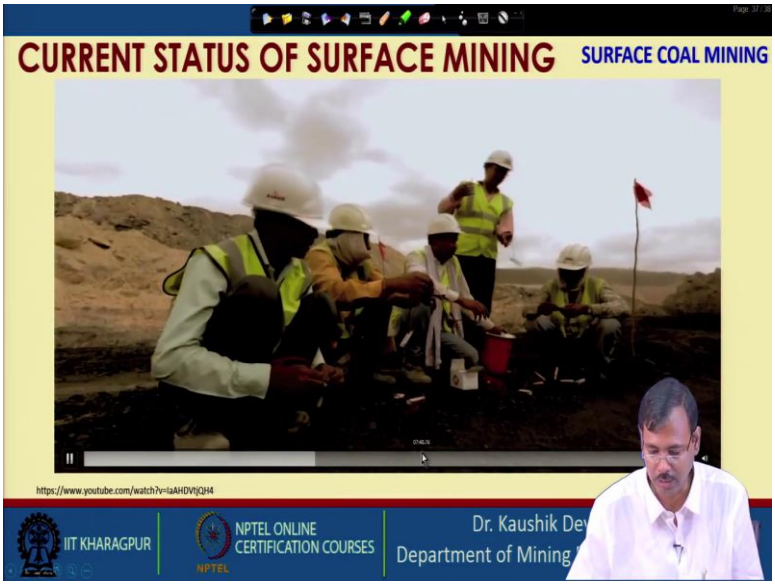

This is a small video related to the surface mining. I guess so, the different surface mining machine you can see, this is, this machine is called dragline. This is the dragline which is having a wire suspended bucket. This is a dumper which is carrying out the material. You can see this is a 240-tonne dumper that is operating here. This is the water sprinkling system. This is the excavator. You can see the shovel or excavator taking the material and loading it onto the dumper.

You see, these are the explosives. They are used for carrying out blasting. You see, this is a very big chunk of rock mass is blasted using explosives. So, this is more or less surface mining technology. We will learn this technology one by one in our future lectures.

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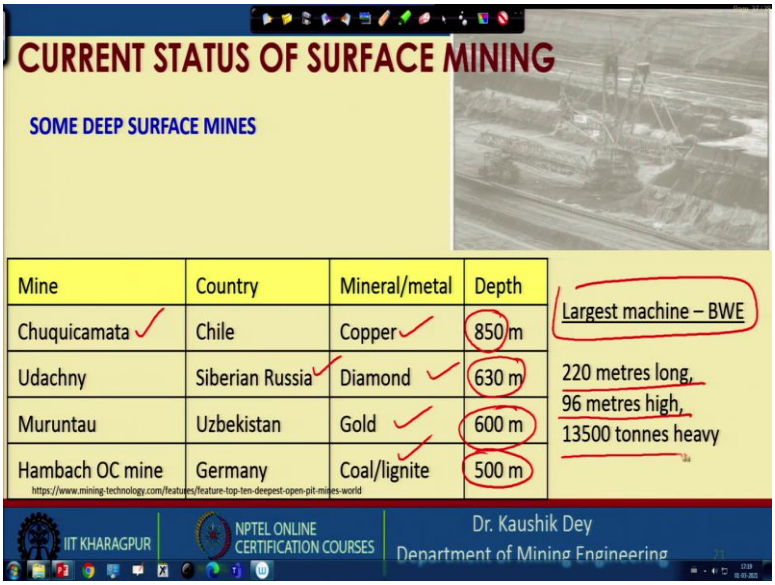

Now, let us have a little bit of idea about the notable mines of the world. This is the second deep most mine Chuquicamata that is also on copper 850 metre deep. This is the Udachny of Russia diamond mine. This is one on one of the very deep most mine This is gold mine is Uzbekistan 600 metre and Germany is having this is the deep most coal mine of the world that is, they call it brown coal, that means lignite of Germany.

And some of the big machines that you can see in this figure, this is the largest missing of the world 220 metres long, 960 metres high and 13500 tonnes of weight. This is a bucket-wheel excavator which is termed as the largest machine in the world.

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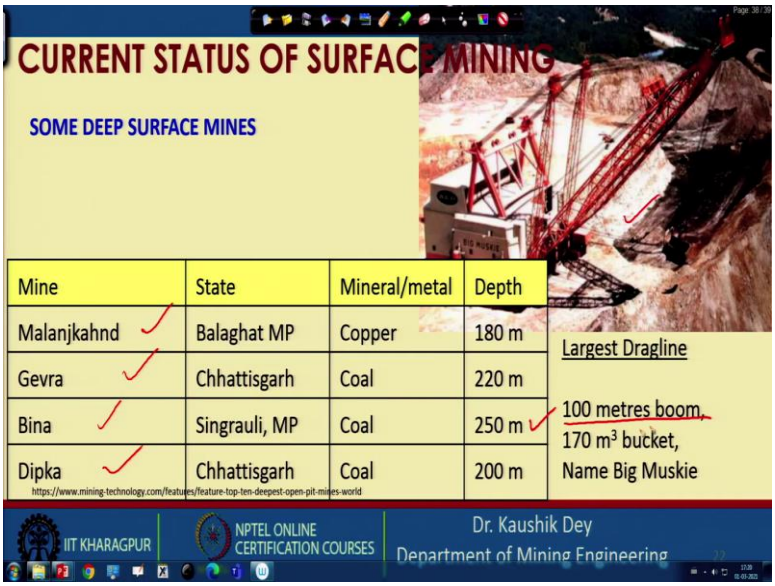

These are some of the important figures related to Indian mines. This is you can see the Bina mine is the deep most mines for the country and Malanjkahnd is a big project Gevra, Bina, Dipka, Gevra and Dipka these are 40 million tonne projects. We are having you can see this is the photo of the largest dragline, which has a 100-metre boom and 170 cubic metre bucket and this dragline name is Big Muskie.

So, this is more or less related to the current status of surface mining, and I wish that you look into the web sources to get more videos. You can observe more videos related to surface mining and different surface mining operations that will give you a brief idea related to surface mining technology. Thank you.