Non-Ferrous Extractive Metallurgy

Prof. H. S. Ray
Department of Metallurgical and Materials Engineering
Indian Institute of Technology, Kharagpur

Lecture No. # 31

Production of Secondary Metals and Treatment of Wastes

I have talked about extraction of gold and we saw that a good deal of gold.

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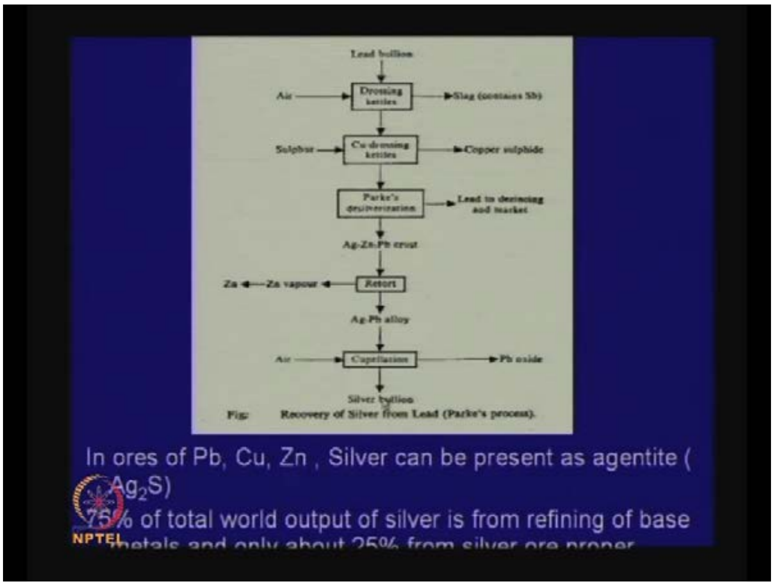

That is present in elemental form the small particles embedded in rock surfaces can be extracted by the cyanidation process. Of course, gold can come from other sources like during the extraction of base metals it will go through the process steps and finally, during electro refining of copper for example, it will be found in anode slimes. Similarly, in the case of silver, there are also silver ores and some twenty five percent of silver is obtained from silver ore proper, but seventy five percent of silver comes from the during the processing of base metals. Mainly processing of lead, because lead ores contain silver as a g 2 s.

I have had I have mentioned how you remove silver during refining of the lead bullion that is produced in the lead blast furnace. Let us quickly go through that step again the base bullion that is produced in the lead blast furnace, contains many impurities and one important impurity is silver.

Now the essential steps is that by aeration and drossing the slag would be removed antimony will be taken out, then by addition of sulphur copper will be removed from the bullion. Then there is this parke this desilverization process which remove silver that is by addition of zinc. When zinc is added to lead there is a silver zinc lead crust that forms the rest of the lead will go for dezincing to market. And from that zinc can be separated it out by volatilization we are left with a lead zinc alloy again after cupellation silver bullion is found. So, much of silver comes from the during the processing of lead that is one of the main sources of lead production.

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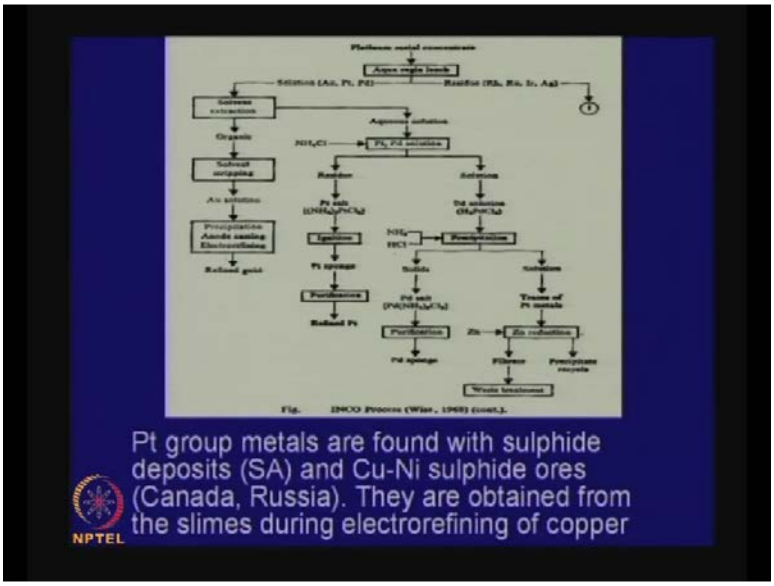

Now, let us come to platinum group metals, again platinum group metals are not found as metal chunks of metals here, and there they are found with sulphides deposits of South Africa or copper nickel sulphide ores in Canada and Russia. And again I mentioned the sulphides are very good solvents for precious metals gold silver and platinum. But, in our country the sulphide deposit that we have do not contain that much of platinum group metals contains gold and silver all right, but in deposits of South Africa sulphide deposits there are lots of platinum copper nickel deposits of Canada and Russia also have platinum. And they can be derived obtained from the slimes during electro refining of copper everywhere may be in our case also there can be some amount of platinum, but let us see how it is done in those countries where there is lot more platinum metals in the platinum metal concentrates. You have to find the way of making concentrates like you did in the case of gold before it going for cyanidation.

Now in this case the leaching reagent is not cyanide, nor acid, nor alkali they are highly noble metals so they have to be leached by aqua regia in aqua regia is a combination of 2 acids. Now in aqua regia again, some metals like rhodium, ruthenium, iridium, silver they do not dissolve in aqua regia that will form a residue and we talk later about how we treat the residue, But platinum gold and palladium they dissolve in aqua regia. And after you got a solution, we go through solvent extraction, in the organic phase gold will come in in the aqua's phase we will go platinum and platinum rhodium platinum and palladium. So, there is a separation here during the solvent extraction of process gold goes into the organic phase solvent stripping, will give gold solution then it can go for precipitation anode casting electro refining ecetera.

We get gold form here the aqua's phase we will have platinum and palladium. And there are chemical steps for precipitation of these. Like ammonium chloride treatment we get the solution that will have palladium and solution, and there are certain steps ecetera ecetera you get palladium here. And for platinum we have some steps. So, essentially the important thing that I want to impress is, in the case of platinum we cannot have cyanide leaching acid leaching or alkali leaching we have to go for aqua regia. Which will dissolve gold platinum and palladium and there are ways and means, of separating them. The residue that has the other platinum group of metals and silver that will be treated separately.

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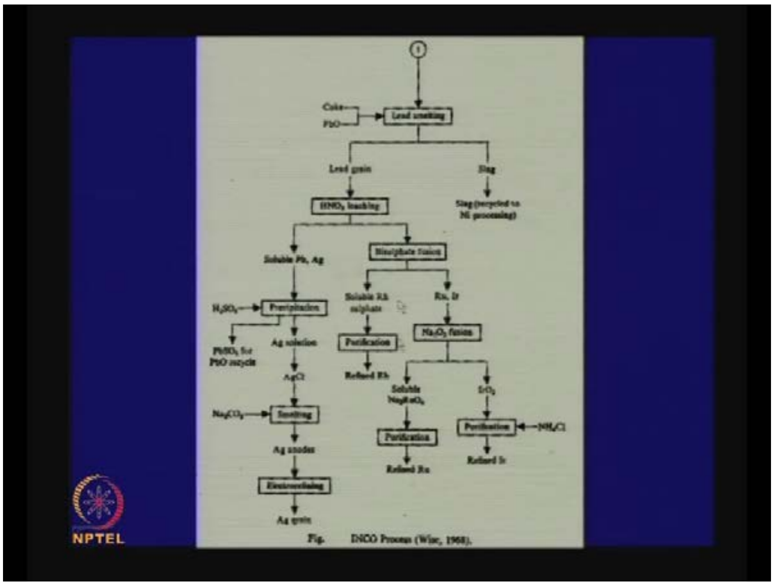

Now this is how we separate. Now there is silver there now silver always dissolves in lead. So, the first thing will be to take out the silver by dissolving in lead which will be produced by a pyrometallurgical process very interesting process. So, we will go for a lead smelting with the residue and we will add p b o and coke. So, that we produce lead that will dissolve the silver that is there in that residue. So, the slag contains the lead that comes will have that silver the slag would have some nickel that will go for nickel processing because normally as I said it comes from sulphide which are which contain nickel, but the lead would contain silver and the other thing. So, ammonia the nitric acid leaching, will take lead and silver in the solution, and then there is a way of precipitating taking lead silver in solution then certain steps we can get silver grains.

Whereas the residue after bisulphate fusion will give us r h and iridium. These are various chemical steps. The things to remember is after aqua regia leach, we get a solution which should have gold and platinum palladium the residue would have silver and other platinum group of metals. Silver will be recovered by taking into solution in lead. This lead is introduced as p b o and introduced into a smelter like, like blast furnace operation where coke is also introduced, and lead bullion will have in it silver. It will also have in it the r e r u and iridium. So, these are various chemical steps you need not know the details ok.

Now, that brings me to the last thing I want to discuss, before I finish extraction of nonferrous metals. And then I would like to move into the subject of energy and environment. In relation to whatever we have discussed with them. I have mentioned earlier the secondary metals come from scrap. What is the importance of secondary metals the importance arises from the following considerations? First if scrap is recycled then the environment is cleaned suppose you find a junk yard of metal scrap all kinds of metal, it is occupying land it is an ice ore is bad for the environment, it could have some unpleasant consequences, but it is a it is a valuable material simply discarded at waste. So, it cannot be tolerated in environment.

So, we need to take it out of the environment recycle it after cleaning. Now producing metals from scrap requires less energy obviously, because we have already brought it up to a high metallic value at one time it was the metal. Now as a scrap also most of the metallic value is intact, it has been rejected, because it is no longer useful for the consumer application or it may have picked up minor impurity elements, and when it left in the environment it will pick some impurities form the environment, but essentially it is it has a metallic value intact. So, obviously we can far more easily extract metal from that than metal from ores and minerals. So, reducing or producing metals from the scrap will require less energy bulk of the work has been done already there is another advantage. If you recycle metals the scraps then you are not causing depletion of the primary resources. You do not have to go to fresh ores and minerals for extraction of metals that you can get form the scrap.

And when you leave the primary source of the intact which means, you are leaving the land intact you are not touching the ores and minerals. And I also mentioned sometime ago that eventually a day will come when we will have we will not touch the earth too much we will keep on recycling whatever we have produced by the industries it will be recirculating. Some amount may have to be formed, because after all it cannot be hundred percent recirculation.

But, that should be the gold that we we recirculate as much as scrap as we can. So, that we do not cause depletion of primary resources if we can help it some amount we have to be. Now I mention that by recirculating actually you save on energy consumption. Why do we need so much of energy for producing metals from ors and minerals? Because, first of all many of them are not present in as high grade minerals many of them are presenting vary minor amounts and so you need elaborate processing steps, and they that require a lot of energy I will discuss later even crushing and grinding require enormous amount of energies. When you have a scrap many energy consuming steps are not there anymore. And that is why energy requirement for the secondary metal production would be much lower now here are some figures,consider magnesium primary from ore. So, many million kilocalories per ton 90.2 from secondary sources it is only three, if you have magnesium scrap aluminum 61.5 why they are so energy intensive, because they depend on electrolytic processes which require lot of energy, it is only 3 nickel 36.3 3.8 zinc 16. 4, 4.5 steel 8.1, 3.3, 6.8 and 3.3.

Why here the energy consumption from primary ore is not so high, obviously for steel the iron ore is very high grade, you do not have to go through elaborate beneficiation step. In the case of lead it is so easy to reduce you can the blast furnace operation is at a lower temperature. So, in this case also the energy requirement is far less compare to the energy requirement for magnesium metal, but still there is a lot of difference in the energy that we require to produce steel from iron ore than steel from scrap or lead from primary resources than lead from secondary resources. Now I have forgotten to type the figure for copper which I will do after this lecture, for copper this will be 20 they from primary sources it will be 28.2 and it will be only 4.5 here 28.2 and 4.5 for copper.So, in all you see in all cases it is far easier energy wise to produce secondary metal as compare to production from primary sources.

Now there are some practical problems the practical problems are collection of the scrap it is not always so easy. When I was very young I was interested in trying to see, if we can recirculate the from the ordinary batteries, the metal strip that we have you take this ordinary torch batteries, if you remove scratch the surface remove the piece of paper you will find a a zinc strip all around it is very pure metal. Why cannot you take that out and produce recirculate that metal. The problem is there are logistics problem and I return to a company, the company said it will cost much more to collect the used batteries from wherever they are discarded and take that piece of metal and clean it and produce it then what we get from primary sources. Which is true, because we do not we can produce now, with with a reasonable cost from the primary sources we are not worrying about.

Because, suppose we dint have the metal form the primary sources, you would have to fall back upon it and find the way of doing things for example, why could not we have a metal that every time you buy a new battery from a shop. You will be required to submit the old battery or the shop owner will give you a discount for the old battery. If that was there the retail outlet should also become collection centers for the scrap from which again the companies can buy that it is not done, but I believe in our country there is a phenomenal number of entrepreneurs about which you do not know there must be people who are doing this already, because there are entrepreneurs who recirculate so many things in so many ways, I have seen old tyres will cut and used for making very in expensive chapels. I do not know whether you have seen it is a very innovative way of using discarded tyres otherwise tyres are of no use at all, and rubber companies are not interested in collecting old tyres and and reprocessing them.

But, people do take old tyres cut them into chapels and those chapels are very long lasting, because tyres have very tough rubbers similarly, I suspect there are entrepreneurs who do this collection in all the ragged pickers we find they pickup things there organized group who have been trained to pick up this or that. So, many metals are recirculated, but not in an organized manner now there is a danger if things are done in a disorganized manner then there can be some unhappy consequences. Let me give you an example of something which can be recirculated quite easily it is the secondary lead. You know this lead scrap does not

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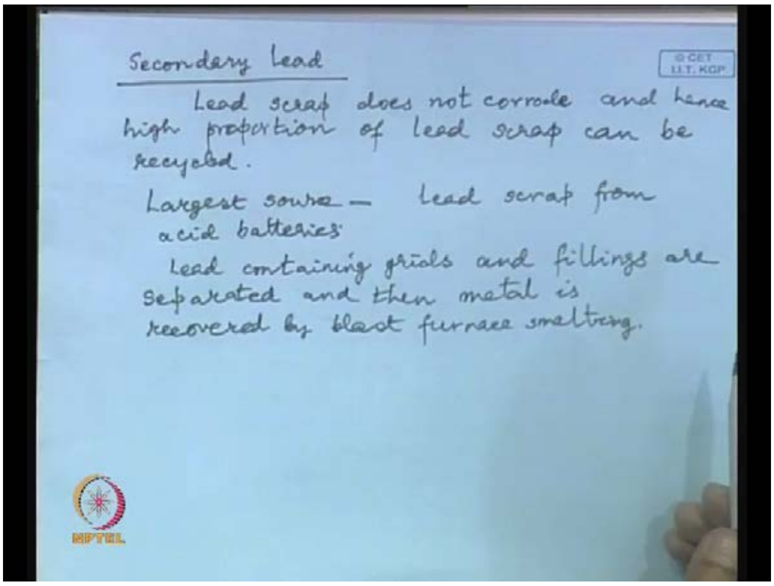

Corrode, because lead is something which can stay for centuries as it is actually many roman ruins are now being excavated I mean, the roman's used lead in piping extensively. So, many roman buildings when they are dough out today they find that lead pipes are still intact they can still used for plumbing. Now it is another matter that is about not a very healthy thing because that can lead to late poison, but the fact remains lead scrap does not corrode and hence high proportion of lead scrap can be recycled easily. When the largest source of lead scrap is from acid batteries, all the acid batteries you see in cars they have plenty of lead in there. So, the first thing will be the lead containing grids and fillings are separated, and then metal is recovered by blast furnace smelting very simple. Now this is one case where you can go and give the old battery and buy a new battery and they will give you some discount. Say an old battery lead acid battery will cost some four thousand rupees perhaps they will give you two hundred to three hundred rupees for the old battery.Why because there is organized way of recirculating the lead using batteries unfortunately. We do not what happened to that old battery then that again goes into the hands of the disorganized sector. I was told and maybe it is still true that in calcutta there are hundreds if not thousands of small entrepreneurs whose job is to produce lead from the lead in old batteries.

What they do is break opened up the battery take out the lead plates, and they have homemade blast furnaces. It is not very easy you know some kind of this drums that you use in the road making the cold tar comes in those drums, they will put some refractory bricks inside, and they will put the lead thing here, they melt it and they would have some flux and may be they would put some there will be some air injection of water they will create some slag to take out the impurity and lead will come out with or without air blast whatever. Now this is very dangerous, because if you are doing lead smelting in these crude furnaces we generate lot of lead fumes. And many of these operators are inhaling that fumes and dying. So, this is illegal. So, what the government does is once in a while there will be some some police man will come to enforce environmental regulation they will close down when this is happening. And if they close down what do they do the people simply go to another place and start doing that. This would not have happened if we had an organized way of recirculating lead I am not very aware where this happens because again when it is done in a small scale by private entrepreneurs, you know they do not work for too much of profit they work just to survive so. It is very difficult to kill this practice all over Calcutta in all many big cities this is happening. And more cars we have on the road more of this will happen there' will be more lead fumes not only locally, but the lead lead fume should also travel to longer distances in the neighborhood also there will be lead lead fume it is happening.

Because, it is very easy to recirculate here, lead does not corrode all you need the collect them melt them if there is some impurity slag them up the whole things comes out of the lead and there is a ready market for it. Lead can be sold it is a commodity which has a utility value which has an exchange value it can be sold very easily .It is not so easy for some other metal scrap for example, consider secondary zinc. zinc secondary zinc

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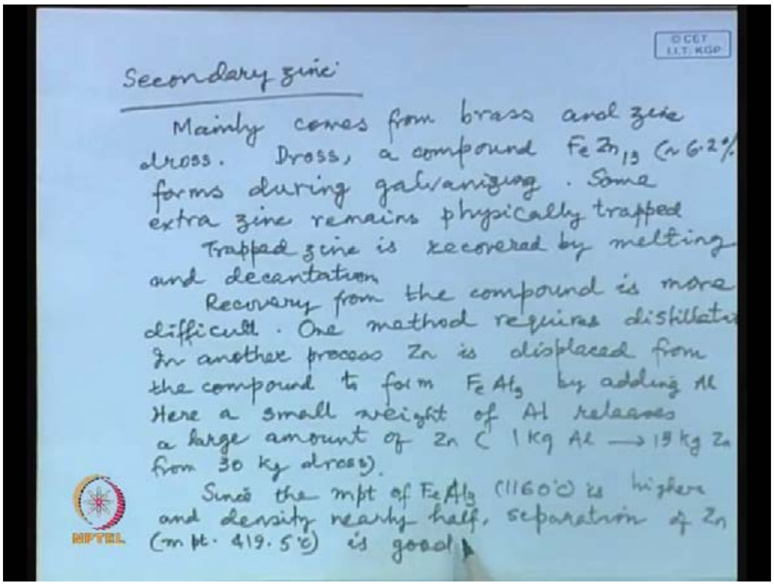

Mainly comes from brass and zinc dross brass you know brass is a copper zinc alloy which is found in so many places. You know all or vessels and copper brass plates brass gadgets cut short, but most of it comes from zinc dross zinc dross is formed during galvanization all the steel pies that we find a white zinc layer there for protection from corrosion, they are made by dipping the steel pipes in module zinc and a layer of zinc coats the surface of zinc. Now when surface of steel when that is happening some iron ore should dissolve in the zinc bath. So, after sometimes we form something called dross which is no longer effective in doing galvanization, it has to be thrown out. So, you start with pure zinc a pool of pure zinc which is used for galvanizing steel pipes.

But, during the process of galvanization some iron is also going into the zinc pool. And gradually it builds up into dross which is no longer effective in galvanization it has to be removed and thrown out. This dross actually is a compound this formulized f e z n 13 it contains about 6.2 percent iron the rest is zinc zinc after all is a very high atomic weight. Now this can have some extra zinc also trap, so the the whole zinc dross is not f e z n thirteen it has some zinc trap inside that. Now how do we get zinc out of that so that we can it can be recirculated it is easy to remove the trapped zinc, to remove the trapped zinc we simply have to melt the whole thing and by a decantation process zinc can be separated out. Now recovery of the zinc from this compound is more tricky. One method would be distillation that yes we can take it up to high enough temperature that will break it and zinc can be distilled off a simpler, process would involve displacement of zinc by aluminum which from f e a l 3 and this can be done by adding aluminum to modeling dross.

Now here the a small amount of weight of aluminium is going to release a large amount of zinc, because first of all and it comes to one kg of zinc we will produce thirteen kg one kg of aluminium will produce thirteen kg of zinc from thirty kg dross, but you are consuming some aluminium you have to find out economics of that you will waste one kg of aluminium but, you will produce thirteen kg of zinc and you are going to treat thirty kg of dross may be there is some use for f e a l three, that I do not know. Now why this process is very attractive is, because the melting point of the f e a l three is (1160) degrees it is higher and its density is half. So, separation form zinc which melting point of four hundred and nineteen is good. So, in the dross when we add aluminum will form f e a l three, it will get separate out very easily from liquid zinc whose melting point is lower. So, we have a clean separation of maturely zinc and solidity a l three, but we have to consume certain amount of aluminium so you have to waste that so these two are very important processes for recovery of lead and zinc.

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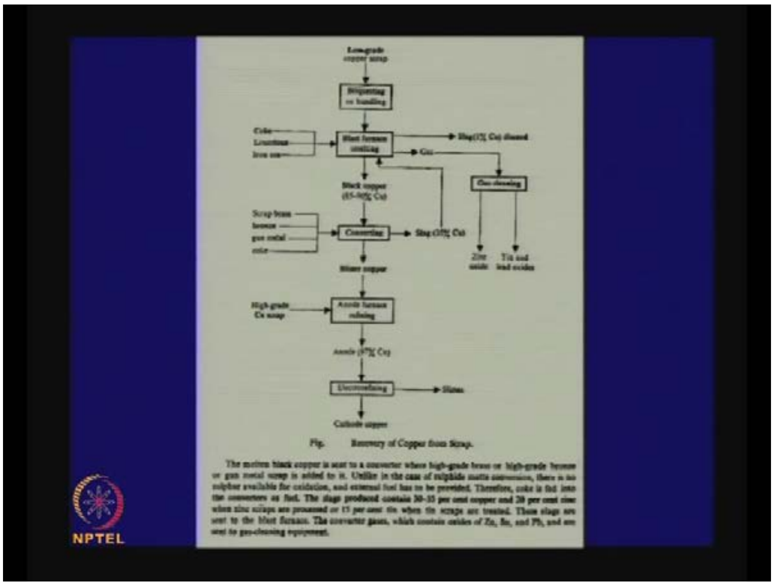

As regards, recovery from copper scrap I have given a flow sheet here you can try to see and I will try to read it out. If we have low grade copper scrap, one way of getting copper will be to have it and in in a compact form then, it will go for blast furnace smelting where we had coke where we had limestone where iron ore. So, it is almost like a blast furnace smelting for production of iron the idea will be to produce black copper, which will have iron and copper together, there will be a slag which will have a small amount of copper that is discarded.

There will be gas in that gas there can be zinc oxide there can be tin or other lead oxides, if that is there in the copper scrap, but essentially we are taking out copper through blast furnace smelting as black copper containing eighty five to ninety percent copper and rest will be iron. Then it will go for converting like what we do in the copper process during converting we can add scrap grass, we can add bronze we can add gun metal, all which contain copper in the scrap. We add coke during converting that slag will produce we will have copper it'll go recirculate for blast furnace smelting, but after converting we can produce blister copper as we did in the case of copper. So, you see here we are using all kinds of scrap scrap, brass, bronze, gun metal and to start with we do that, but then the whole idea is to first take it into first a black copper thing with eighty to eighty five to ninety percent copper. Then we go through converting blister copper, then in that we can add high grade copper scrap now we have a anode furnace refining, we get an anode ninety seven percent copper then it will go for electro refining.

That electro refining will produce some slimes, you may or may not have precious metals. So, to put it in words the molten black copper is same to a converter where high grade brass or high grade bronze or gun metal scrap is added unlike in the case of sulphide matt conversion. There is no sulphur available for oxidation and external fuel has to be provided that is why we are providing coke for converting. The slag produced contain thirty percent copper and twenty percent zinc and zinc scrap are are processed for fifteen percent tin when tin scrap are treated. The slags are same to the blast furnace the converter gases which contain oxides of zinc tin lead are send to gas. So, it is a process mainly if I essentially getting copper from all kinds of scrap, but in the process there'll be some zinc tin lead etcetera. There is a probation for recovery this all. Now one very important secondary metal is aluminium. How are you going to recover secondary aluminium, you will find aluminium in our everyday life you know used door frames window frames all kinds of aluminium, containers, vessels what we do with all that aluminium that are lying around. And the use of aluminium for structural applications and the manufacture of continuous is increasing gradually. So, the amount of scrap also would be more as time goes.

The secondary aluminum would also be there in scrap material in turnings, borings, streaming, foils can etcetera. The process of recovery of secondary aluminium will be melting of scrap either in a reverberatory or rotary furnace; using some fluoride fluxes these fluxes prevent a loss of aluminum due to oxidation. Problem is when you melt aluminium after you have to come up with a very clean ingot of aluminum it tends to oxidize so we need to cover it up with a fluoride slags.

Now I will read out one or 2 sentences from my book for recovering aluminum from impure and mixed scrap a short shaft furnace is employed, this furnace has a slopping hearth on which the scrap is melted, and a fore hearth in which the molten aluminum is collected. The unmelted iron and steel are rate out of hearth the aluminium thus obtained is used to make aluminum copper or aluminum silicon alloys or used as a dioxident in steel.

The impure aluminium can be refined by the bake process, in this process twenty to thirty percent of magnesium is added to impure aluminium and a mixture cooled to a temperature that is about one hundred and thirty degrees about the freezing point of aluminium. The metal is next filtered or on a perforated iron plate filter crushed basalt as a filtering medium the resulting resulting liquid aluminium is vacuum refined. In a vacuum induction furnace and finally, get an aluminium that is suitable for commercial production of light alloy one taken. So, there are methods of processing aluminium scrap for production of aluminium that can be go into the industry again.

So, for all kinds of scrap metal there are many many methods. I will mention only one now which is secondary tin you know in all steel cans that are used to contain beverages, food items there is a thin coating of tin. And I think I mentioned about may be less than one percent of the total weight is the weight of that layer of tin, but that layer is so important we used our tin to indicate the steel containers. Why we have that layer, because it is not toxic it resist corrosion and just the ideal material. What happens after you throw away the container? The problem is if you do not remove the tin layer then the container is also not a good scrap for steel making, because if the container is sent to a for steel making then the slag would have tin in it tin oxide, and tin reduce may get into that metal also, it it interferes with steel making process. So, it is neither going for tin production nor going for see recirculation of iron. So, if we can remove that tin layer then it becomes a scrap which is valuable for steel making also and we get value in terms of tin.

Now there are many methods of recovery of that layer of tin. And nearly fifty percent of tin produced that is used in the production of plates. The metal is also used as constitute in soldering alloys you know the soldering alloys are scraps also, bronze and Babbitt alloys also have tin. It is added in some plastics to ensure transparency, the tin is a constituent of paints industrial fungicides and disinfectant it has lot of uses, but there are some uses which which which make available scrap from which we can extract tin. For the recovery point of view the tin can scrap is the only worthwhile source tin can scrap that is from where we should try to get tin. And the recovery of tin as I mentioned also render the steel can suitable for use as a valuable scrap addition during electric furnace melting of steel. Tin coated steel cannot be charge in an electric furnace because tin is an unwanted alloying addition and s n o 2 length of the slag phase creating operation of problems.

The normal thickness of tin coating is 1.5 in the ten to the power minus four centimeter and the weight is about one percent of the tin can. So, there is good amount of tin if you can collect a whole lot of cans essentially there are two approaches to that one is leach it out. I mean, use a leaching reagent which will not attack steel, but will will dissolve tin there are processes alkali process or some other chemicals which can do it. The other is a chlorination process, where tin is recovered in the form of liquid chloride by being made to react with chlorine gas. And suitable temperatures when made to react with chlorine we can produce s n c l 2 which is a liquid which will simply come out of the surface of the steel surface. But of course, the precautions must be taken to exclude all traces of moisture from the processing in order to avoid corrosion of iron, because you are going to a higher temperature. Moreover it is also necessary to ensure that the material this free from all organic substances such as paper straw.

There are some other details that I can I can exclude actually it is an exothermic process. Tin 2 c l 2 s n c l 4 it is the tetra chloride that comes out by chlorination and exothermic process and when chlorination is complete water is cautiously added to cool the liquid. And the at the stage essential for crystallizes out once you have the essential for which is starting material for tin production that is not difficult. Then there are some electrolytic processes that you you take it into a solution then electrolytically electrolyze. So, I have given examples of zinc, lead, aluminium in the case of all nonferrous metals there are methods using which you can produce secondary metals. I will not go into it any further, but at the end I would like to mention, and there will be reference to this in the next module when I talk about energy and environment.

In many metallurgical processes for extraction of nonferrous metals. We produce a waste not the I am not taking about scrap, we have produced a waste in some step, which takes out important metallic values not metallic value of the metal we are aiming at, but some other metals are in the waste. And we can get metal from those wastes I wouldn’t call it secondary metal, but we will call metals recovered from wastes there are also application of wastes in some form or other. So, I want to mention one or two words on this. We can get byproducts from slag’s in all pyrometallurgical processes we are producing slag's from slag's we can produce cements we can produce slag wool we can produce insulating material we can produce some ceramics called slag ceramics, but more important is there are valuable metallic elements in many waste products.

One of the most important things is, the vanadium present from leach liquor during aluminium processing and red mud, and vanadium is a very valuable element, which is there in the aluminium circuit, Vanadium occurs as a trace impurity in bauxite and constitutes about point 0.5 percent by weight in bauxite was found in Bihar and some other states. During alkali digestion in the bare processes nearly one third of vanadium also dissolved in the process liquor from the liquor we have to get vanadium out some vanadium will go into the slag, we have to find extracting vanadium from the slag from red mud. Now I have told red mud is also very rich in titanium and iron. So, we are not talking about ferrous metallurgy, but we can find ways and means, of getting titanium out of the red mud. So, similarly, there are many many things in nonferrous metallurgy but, then red mud from the aluminium industry is the most important waste product that goes practically unused and there are heaps and heaps of red mud everywhere, and the aluminium industry does not know what to do with this red mud.

And this red mud simply is kept in ponds which occupies large areas. I read somewhere that in West Indies, which is one of the leading producers of aluminium. Some eight or ten football fields size land is consume every year for simply keeping the red mud. It cannot be dumped into the sea there are lot of problem. So, they have to find eight or ten football field size areas just to dump red mud. In Orissa we have if we go to damanjodi huge areas have red mud simply for dumping. Now there is a problem there it simply cannot be dumped like this, because if it is in a heat during rains it'll all or the flow out and it is alkali there, because some alkalis will remain a red mud and the alkali if it goes into the agriculture areas and other areas you will play havoc. So, they have to be some kind of cemented tanks in which red mud has to be kept. So, it is a big problem, because the red mud is actually leach residue that is coming from from the bare process it contains up to twenty percent a l 2 o 3 also, 50 percent s I o twenty two percent f e 2 o 3 and thirty percent t I o 2. So, it is also a potential source of aluminum it contains aluminum.

It is a potential source of titanium and the amount was huge. I mean, for I have given the data I think maybe I will discuss it later it is not small quantity that you are producing. There are other industries where you are also producing huge amount of wastes an example, is the titanium industry during processing of ilmenite where our aim is to produce synthetic root I t I o 2. So, we need to take out that f e o part and that is rejected and kept at one place about forty percent f e o rejected. There they are also heals of that I have talked about chromite mining in the chromite mines. The top layer soil layer or we call the overburden is first removed. So, that we go into the interior to get to the chromite rich layers the overburden contains nickel about point 6.7 percent nickel and also one tenth of that of cobalt is in the chromite in the chromite overburden that have been accumulating in sukinda mines of Orissa. There are thousands of ton tons of nickel and cobalt in that overburden we still do not have an industry operating to extract that nickel and cobalt. And we are importing all the nickel and cobalt we want we do produce small amounts by processing some secondary sources for example, I know there is a company in Baroda which imports from abroad secondary alloys. I mean, scrap because scrap stainless steel or catalyst which contain nickel and cobalt and they are processed to produce nickel and cobalt.

But, we do not have an indigenous industry for production of nickel and cobalt which can be there, if we can process the sukinda mines chromite overburden. Now we have developed processes in the laboratory scales laboratory scale, but for various reasons we haven't been able to put up a commercial process. There are many other many many other similar, metallurgical wastes where metallic values are present and we need to consider how to recover that, I think I will stop it there now and this discussion is taking me very logically towards the issue of energy and environment. And this is what I will do in my last module of lectures and I will do that quite quite thoroughly actually I will discuss over the next five or six lectures, issues related to energy and environment when some of the things and we have mentioned earlier will be mentioned again in a little more detail like we mentioned to produced lot of metallurgical wastes during the processing of any many nonferrous metals I will discuss that again what happens.

But I would also introduce some very general concept as regards energy and environment these are important, because today the no issue is more important than the issue of energy and environment people are talking about climate change and I am talking today is 22 December 2009 only till yesterday for many days a big number of countries discussed in Copenhagen the the issues of climate change and global warming now the contribution of nonferrous metal extraction processes towards global warming or climate change may not be very large and I will tell you it is not very large.

Even for the steel industry the contribution to c o 2 emission is only about five or six percent but, that does not mean that we can be everybody has to work towards mitigation of environmental problems it should not only for global warming, but for local health local survival for our own prosperity for a cleaner lifestyle everywhere we have to worry about environment issues and most of these environment problems are coming from use of excessive energy we have to cut down on consumption of energy these issues we are going to discuss.

Now since I mentioned today is twenty second December I do not know when you are going to listen to this lecture but, since Christmas is only a few days away I must wish you marry Christmas and a very happy new year only which is a which is a few days from now. And with that I discuss extraction of nonferrous metals from ores and minerals and also extraction of nonferrous metals when they are not from ores and minerals, but they are in elemental form, but along with a lot of gang. I have also discussed production of secondary metals which is extraction of metals from scrap. After I discuss energy and environmental issues. I will take may be two lectures, to go through the entire course once again because I believe you understand processes when you know the principles but, you understand the principles better when you have understood the processes. I hope at the end of all these lectures, you have understood a bit about the processes of extraction if I go back to the principles again you might understand them bit better. So, with that I conclude module number eight and the next lecture, we will start with a last module that will deal with energy and environmental issues thank you.