METALLURGICAL AND ELECTRONIC WASTE RECYCLING

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Lecture-41: Conclusion

Greetings, I welcome you all to the concluding lecture of this course wherein now we are going to just collectively revise what we have been discussing in this course and we should be focusing on the topics that we have covered so far and how we are learning and relearning and implementing these ideas into developing newer technologies and strategies for materials recycling. Let us just focus on the important topics that we have covered in this course and then we will be trying to recapitulate as much as we can. Classification and categories of metallurgical and e-wastes.

Some of the important topics that we covered are basically one of them is classification, categorization of metallurgical and electronic wastes. Those classifications had been discussed. We had also been focusing on the pre-treatment, pyrometallurgy, hydrometallurgy, electrometallurgy and refining strategies. Why are these so important? Because we know that when we studied about so many different types of strategies for various types of waste streams, we know that one has to follow one route or the other and it depends upon the material waste itself. The classification becomes important, categorization becomes important. We've seen sorting is one of the most important crucial operations that we should be doing at the beginning itself, material characterizations are so important and then we think about the waste what is the most important material that we should be extracting and based on that what is a good strategy. Pretreatment, pyrometallurgy, hydrometallurgy, electrometallurgy are the collections, the segments that we follow one after the other they could be followed. This could be followed in combinations and finally, one would like to refine the product that they have made.

If it's a metal, we would like to go for refining of metals or if it's a chemical product, then we could be refining or making it better by removing all the side impurities that it may contain. What are the important wastes that we have studied? When we look at aluminium wastes, we see dross, spent pot lining, red mud, scraps, steel slags.

Aluminium had these wastes. Copper, we had studied. Copper smelt slags, raffinates, spent electrolytes and scraps. When we looked at zinc, we studied ash, zinc ash, zinc dross, dust, zinc dust which was coming from various sources majorly comes from the iron and steel making industries and zinc scraps.

When we looked at iron and steel making wastes, we have covered iron making slags, steel making slags, steel making scraps and wastewater. Wastewater that is generated in the iron making and steel making industries. What happens to those waste streams what how do we recycle these wastes. In the metallurgical engineering segment, the metallurgical wastes that we had covered. We had these many wastes that we had individually discussed and we have also seen which route is compatible with what waste it only depends upon not only depends upon what, where it was formed, but also on the composition, where, what is the general composition, how do we, what do we wish to extract, what do we wish to produce. Based on so many different factors and process parameters, so at times we might want to have a metal product, but we would instead be making a metal compound because it may be a bit more feasible. Based on all of these strategies, we have studied so many different types of recycling routes.

When we move to the electronic waste segment, so we had covered the PCB, the waste printed circuit board, waste WPCB and the batteries. Before we went into the PCB, we have also seen the recycling of general electronic waste. AC recycling or washing machine recycling that part we have also covered. But majorly we have been discussing about the printed circuit boards and the batteries. In waste printed circuit boards, we had seen the delamination and the recycling strategies. Again, coming back to the original basics that we had laid the foundations of. Pre-treatment, pyrometallurgical route, hydrometallurgical route or trying to fuse these strategies one after the other. This is how we handle different types of wastes. Similarly, when we think of batteries, we have studied different categories of batteries, nickel-based batteries, lead-acid based batteries, zinc-based batteries, lithium-ion batteries. As these batteries, we studied individually, what are good routes of recycling batteries, what is an important method by which we can handle these batteries and how we should be pre-treating these batteries so that these batteries are safely dismantled before we even think of recycling, how we should be handling these batteries. All of these strategies we have covered step by step. We have studied these processes; we have also seen what are good recycling strategies in pyrometallurgical or hydrometallurgical way or methodology of handling these wastes.

Apart from that, we have also seen the environmental aspects of every waste. How people are trying to bring in life cycle assessment into the materials recycling because it is very important to understand how materials are being reused and what is the effect it causes, what is the strain, it leads it imparts on the environment, when these aspects are considered, the complete understanding is achieved. When we think of a materials recycling course, there are important aspects that one should be considering. We have environment, we have energy, we have engineering, and we have economics.

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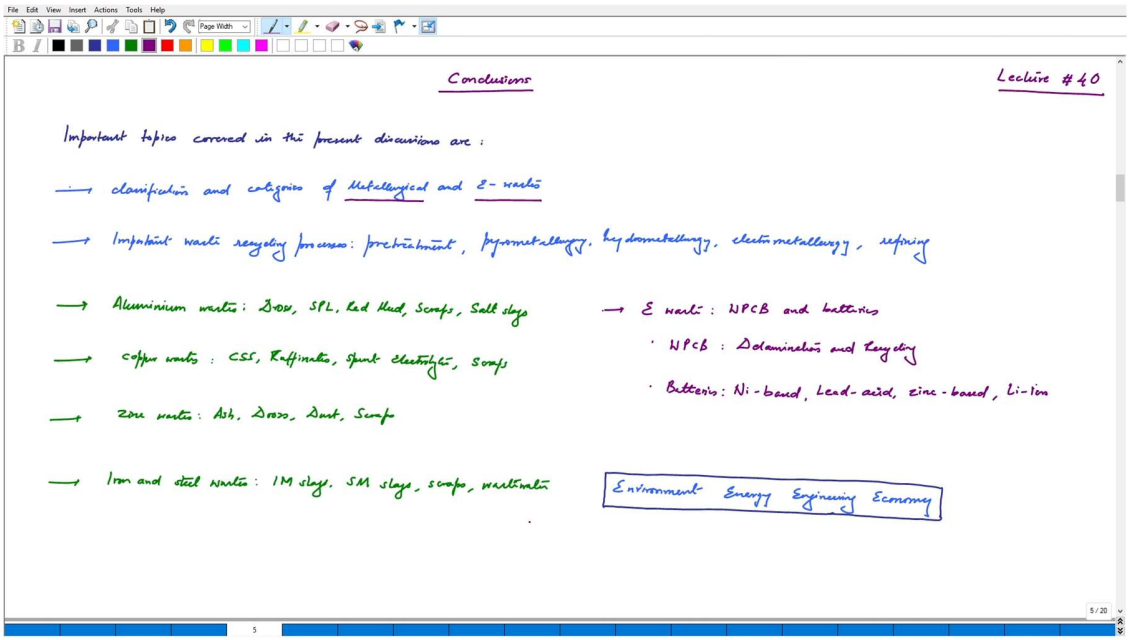

These are, in my opinion, the four important E's of a given process, Environment, Energy, Engineering and Economic. These E's help us in channelizing our focus that what is really important in a recycling strategy. When we think of environment, it may be possible that it may not be completely economic friendly. or if it is an economic process, it may not be environment friendly. One has to devise a recycling strategy for any waste that we have been studying or for any waste that we could be studying on a personal basis. This is very important. Optimizing and finding the perfect balance between all of them, engineering facilities that we have, environmental concerns that are around us, we have the energy constraints and energy recycling, energy utilization and in the economics that drives the whole process. All of these have to be brought at the balance to achieve the best recycling strategy. With this, I bring this whole course to a conclusion.

Thank you very much.