Carbon Accounting and Sustainable Designs in Product Lifecycle Management

Prof. Deepu Philip
Department of Management Sciences

Dr. Amandeep Singh Oberoi
Imagineering Laboratory

Dr. Prabal Pratap Singh
Department of Management Sciences

Indian Institute of Technology, Kanpur

Week 08

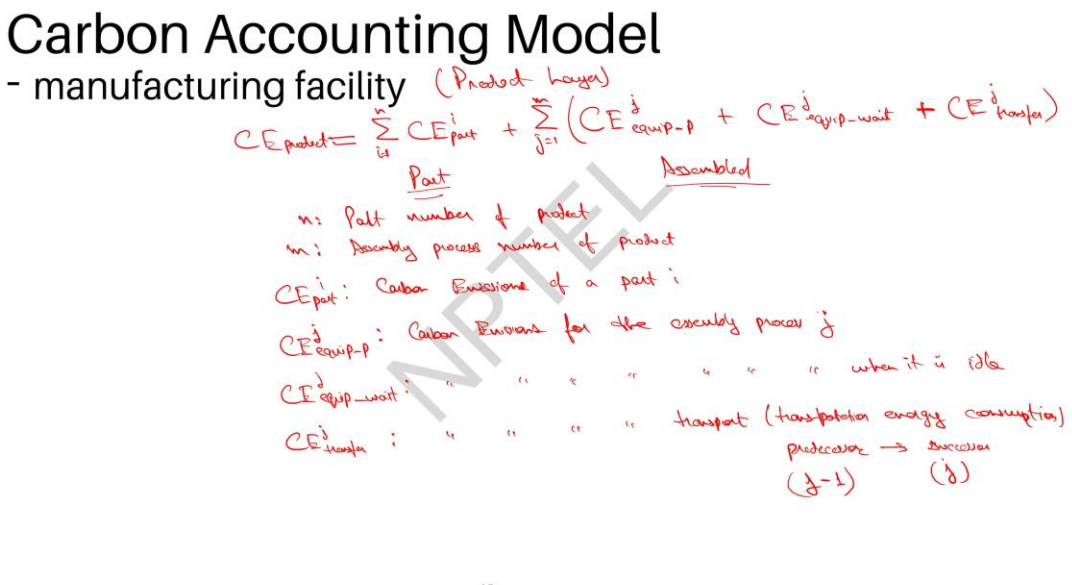
Lecture 36

Carbon Accounting Model (Part-3)

Welcome to the third part of the lecture on Carbon Accounting Model. We are in the course Carbon Accounting and Sustainable Designs in Lifecycle Management. I am Dr. Amadeep Singh Oberoi. I am teaching this course along with Professor Deepu Philip and Dr. Prabal Pratap Singh. We have discussed about the carbon accounting models in the last lectures.

And we have discussed about the different layers of AML flexing facility. And I have talked about the model in a facility umbrella. That is the total model for a workshop or a facility in which I talked about the carbon emissions in product, in distribution, in inventory, in auxiliary and in working medium. Now, I will talk about the product layer and part layer majorly in this lecture. When we have seen the different systems, you call it distribution, inventory, auxiliary and medium.

These are all supporting systems to the major product that is developed in the facility. Now, for a product, how do we put the carbon emissions?



Therefore, the carbon emissions of a product are:

$$CE_{product} = \sum_{i=1}^{n} CE^{i}_{part} + \sum_{j=1}^{m} \left(CE^{j}_{equip\_p} + CE^{j}_{equip\_wait} + CE^{j}_{transfer} \right) \qquad (49)$$

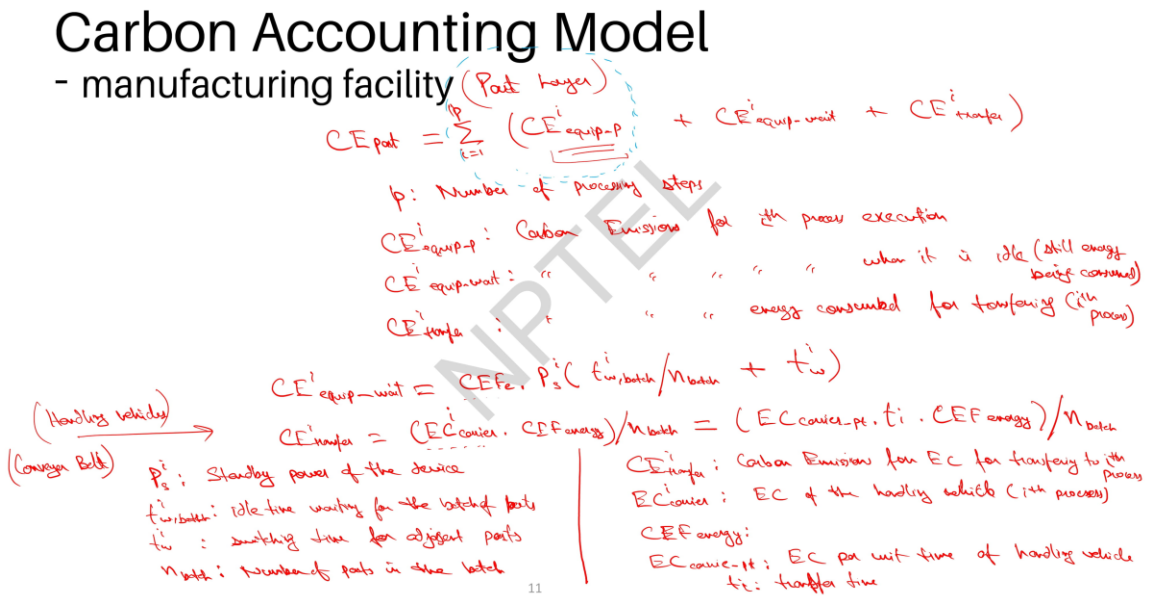
Where

- *n - part number of the product*
- *m - assembly process number of product*
- $CE^{j}_{equip\ wait}$ *- represents the carbon emissions of the equipment idle energy consumption during the assembly process j*
- $CE^{j}_{equip\_p}$ *- represents the carbon emissions of the assembly process j*
- CE^{j} *- transfer represents the carbon emissions from transportation energy consumption of the workpiece from assembly process j-1 to assembly process j*

We are transferring the part from one equipment to other equipment. I will show you a video in the end of this lecture, where we will try to see how different machining operations are there and different components of that machining system. Components means I showed you the graph when the machine is running idle, when the spindle is rotating, when the actual machining is happening and how do we set up the machines. So, those all are part of the carbon emission for a product that is we have. Carbon emission for the equipment_P, which is carbon emission for the assembly process.

Previously, in the last week, I was majorly talking about my facility And this was also about facility umbrella where we talked about the distribution systems. We talked about

the overall workshop or facility in the facility umbrella only. So, in the product layer, we have talked about carbon emission for parts.



We come from the part layer. Let me try to put that as well. So in the part layer as I have already discussed that manufacturing of a part exactly corresponding to a process flow. Therefore, carbon emissions in the part layer would also include the equipment layer would also include logistics and activities. So, carbon emissions in manufacturing equipment layer that could be caused due to process execution, due to the standby power or many other small power inputs which are there.

For conveyor belt, what is there? The belt has to take the material or whatever the equipment system or the car from one place to another and in between the assembly is happening. Here the carbon emission factor would be energy convention for the conveyor belt for the arc process multiplied by the carbon emission factor for that energy. That could be electrical energy only. So, these energy consumptions would be then the sum of the power to run the motor multiplied by time for which the motor is run.

So, that also could be put down here. So, similarly, different energy consumption systems are there. So, I have talked about the assembly. I have talked about majorly some about the part and in the part. The energy consumption in the equipment during process, this is something I will talk in detail.

In the coming lecture, and here I am taking a break and I will talk about the machining, the sand casting, the forging, majorly about the machining.

I will talk about in the next lecture and we will also start that with a demonstration video on how the machine runs and how the power consumption at the different levels of the machines are there.

Thank you.