Umicore at the Core Event in Poland

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Future-proof operations set-up

Michiel De Jonge, Chief Operating Officer, Umicore Battery Materials
Good morning everybody. I hope you enjoyed the presentations that we did yesterday. Quite a lot about how we're developing our product technology for today, for tomorrow and for the future out as well. Today we'll talk about how we industrialize that globally across the world.

Umicore is in a unique position that we have operations all over the world. We have gigafactories running in Korea, China, Nysa, and you've seen the announcement on Loyalist as well, where we started the build of our fourth gigafactory. So we are present in all of the geographies that matter as well.
The most exciting thing is that it's not only PowerPoint. So I will explain about the theory and the thoughts around how we do manufacturing and manufacturing setup and actually see how we've implemented this in Nysa. So you can verify for yourself the concepts that we will talk about today as well. And I'm very confident that we set up our operations
from a future proof.

And why do I say that? From a number of angles. First of all, as Mathias has already explained, we have a modular setup which is suitable for today's chemistries, but also for future chemistries as well and is very cost efficient. And I'll explain you why that is.

We have sustainability at its core. So this is about our greenhouse gases emissions that we have across the globe. Our Nysa plant is set up from the start with green electricity. Loyalist will be as well. And we're working hard to reduce our footprint in Asia as well.
We have a winning team to operate and to build these factories. We have a lot of experience, 25 years of industrializing, building these plants and operating them. And that's also unique in the world of CAM and pCAM as well. And this is all underpinned by a strong digital strategy.
So let me take you through the presentation. I will hand over to Dariusz after around 20 minutes, and afterwards we'll have Q&A. Then the most exciting bit, you get to see the plant in Nysa.

Before I do that, and I go through kind of the setup, I want to go back to explaining a little bit about precursor manufacturing and CAM manufacturing. And this might not be

new to some of you, but let me talk you through the basics and the schematic of how we produce pCAM, as we call it, in Kokkola.
It starts with getting the metal sulfates from my esteemed colleague, Stephane, and mixing those. One of the key important points is impurities control to make sure that we have low level of impurities in our operation in the mixing phase as well. And then we go to the precursor reaction, the precipitation. This is where the magic happened. This is where we determine the core of the CAM performance.
So this is in the precipitation, we control the spherity, the shape, we control the porosity as well. And those are all important for packing density, energy density, mechanical strength, during calendaring and a power to weight ratio. So that's why this is such an important part of the process. And as you explained, as my colleagues explained yesterday, this is also where we've done a lot of development and have protected this by strong IPs as well. So a very key process of that.
Then we have filtering, washing, drying. Why are those also important? Because we need to have a controlled atmosphere, you need to make sure that we have a low carbon uptake in those operations. We need to remove sulfur. For instance, sulfur impurities will give issues otherwise in sintering.
Natrium, if you don't remove that properly, could have issues in bilging and gassing as well. So again, those following process steps are also very important to control that properly as well.
The last thing is the packing. And again, impurities control and making sure we do this under controlled atmosphere, controlling moisture for instance, is very important for the performance of that.

So we have a little vessel over there. How does it look in real life? This is a shot of part of our production facilities in Kokkola. And you see the high amount of equipment that we have around these vessels. We have multiple reactors where we control the precipitation. It's fully automated. There's nobody there. We do a lot of online sampling and measurement to control the precipitation and to make sure that we do this microengineering to get the perfect product as well. So very, very important step in the production of CAM is making sure we have the right pCAM.

Then we come to CAM manufacturing. Again, maybe not new for the audience here and online. Very basic steps, the pre-treatment, firing and post-treatment.
Pre-treatment, this is where we mix the lithium with the precursor. The precursor coming from Kokkola is mixed here. Blending is very, very important to get a homogeneous mixture. Not so easy to get this right. Again, you will see today massive, gigantic installations. More than 100 hectares is our premises in Nysa. It is mass production, massive scale as well. But it is far more great that we are controlling this. I think it was mentioned yesterday as well. Some of these impurities we measure on parts per billion bases as well. So, high cleanliness is also very important. You will see that today. So, very important to understand that
controlling impurities is an important part of our production process.

So after blending and pre-treatment, we go to the firing. This again is where a core of our technology is sitting. That's where lithiation, sintering and annealing is happening. We are controlling morphology. We are controlling crystallinity and size. The ovens that we are using have very precise temperature control. We can go up to 700, 900 degrees. We can control it on a one to two degrees basis, with a certain curve that we have over

that process as well. So again, they might look industrial and a bit crude. They are very, very sophisticated equipment, to make sure that we control the sintering very well.

Last step in this schematic is the sieving. Again, the impurities control to make sure that we take out the oversized particles, the fines as well, to make sure we have products with the right particle size distribution in here.

And again, and you've seen this slide before, Umicore has a vast experience in precursor and CAM. More than 25 years. That's not easy to get. We are the only one who is operating assets in Korea, in China, in Nysa. We are the first, we are the first CAM factory in Europe. We will be among the first in Loyalist and challenging the team to see if we can be the first. We have some neighbors close by. We're in a race to see which plant will be up and running there as well.
And that's quite important because yesterday we talked about the local for local and we are implementing this. We've got this and we're driving this.
Why is it so important? Because if you build factories, you learn when you industrialize it, which is not an easy process, you learn on how to do that best. We know how to do that. We know how to operate in Europe. We've been here for decades, for hundreds of years. We know how to do permitting, how to recruit, attract people.
The same goes for Loyalist. We've been in the US for more than 40 years. We have automotive catalyst plants nearby. So we know what it takes to actually start to engineer and build these facilities as well. And it's not easy to do this, to build these plants.

When we went through the creation of these plants, we keep on thinking on how to improve. Continuous improvement is at the basis of what we do. Everybody in the team is thinking about how to further improve on a day-to-day basis, but also on a bigger topics like design of the factory. And that's why we came up with the modular that you will see here in Nysa. And let me take you through a little bit more on the CAM setup and which type of processes actually are underpinning the production of CAMs.

We have thermal processes, as you can see here. Thermal processes, the firing is the most relevant one. We also have roasting, we have drying. That's a group of processes which is at the core of a lot of our processes in CAM.
We have mechanical processes where we are milling. So we're making the particles in the right size. We can do jet milling, ACM milling in an area where we have the sieving, we have the blending. Again, this is an important part of getting the product right.
And then we have wet processes. Wet processes like washing to get the impurities off. Wet milling, which is a different type of managing your particle sizes. We have wet coating, et cetera.

So these three building blocks actually, if you combine them, will form the CAM process. And what we realized is that, quite soon, is that with a linear setup where you have basically a pretreatment, a firing step, and a post treatment step, you are kind of a little bit inflexible.
You have hard wired, you're hard kind of coded, and you're hard kind of with your piping, et cetera. That process, and that's the traditional linear design where you go from the pre-treatment step, you go to firing and you can go to a post-treatment step.

In our case, in Nysa, we've decoupled. We've decoupled these process steps. And you will see that today as well how we've done that. We've decoupled these process steps

and that gives us a flexibility to go from two pre-treatment facilities to one firing, or from one pre-treatment facilities to two firing, and also on a post-treatment step, and to circle back quite easily to other process steps in this area.

And why is that important? Because chemistries continue to develop. Yesterday you heard about the product technologies. So you need to understand that your sites need to be future proof for that. Today we're building the plants for today's chemistries, but we are also capable to deal with future chemistries in there as well. So flexibility is key. Let me explain it again on a little schematic here. On the right, the far right, you see all the cool products that R&D is developing for us. So the mid-nickel, high-voltage, the high-nickel products as well, HLM, and then further out, we have the semi-solid state and solid-state batteries. We have the DRX, (natrium) sodium-ion as well. Those require different combination of process steps. As we put it here a little bit schematic, so you start with a mechanical, do a bit of firing, you go maybe to a coating process, coating additives, the pepper and salt are becoming more important as well.
Then you have another firing and then you have further mechanical treatment steps. You need to be able to combine these process steps for the future chemistries. We today can do this already in Nysa and we'll be able to do that in Loyalist. So very important that we can combine these different process steps for the chemistry.

So each time Stephane comes up with a new idea, the first question is, okay, talk me through. You know, this solid -state battery seems complex, and he said no, because we have indeed designed it for the future as well. So we're very confident that doing small additions, maybe one model here or maybe one wet milling line in an existing building, we can produce the next level of chemistries as well. And that also helps us with the industrialization of these new products going forward.

So what are the key benefits of this design? Enabling a de-risked and phased CAPEX approach. So we are building CAPEX when we have approved contracts. And there's always a nice tension with my sales colleagues where they said, ah, we need to start up and said, please sign the contract. Nothing will happen before we sign the contract with our customers. So we sign the contract, then we get going. We build the plant in two waves, in two modules.
And we can do that, we can follow exactly our contract commitments with the way we're building up our factory as well. So we adding these modules, we can do it in firing steps of around 20 gigawatt hours. But when we have a new contract or we have additional volumes, which might require one additional wet coating step, we can easily add that to the existing facility as well.

So that's a very clear benefit for us as well. We're more cost efficient. We have a faster scaling and ramp up. And let me explain that a little bit. And if you want to know more, then Dariusz can explain how we commission the factories as well, always an exciting period for a plant.
When you are scaling up, when you're industrializing, when you're qualifying your plants as well, that's a very intensive process. We can do that module by module.
If you commissioned one line at the same go, you might have an issue halfway through the line. You only discover it at the end. You might have an impurity issue with metals. At the beginning, you run that all the way through your plant and you have to clean. You have to clean that plant. Metal is fire basically for us. So you have to do it all the way where we can control these discrete steps as well. So that's very important.

We have a standard design. So we commissioned the plant in Nysa. There is a playbook how we do that. That module is installed in Loyalist. We copy and paste and have the same way of starting up those facilities as well, module by module. And that really helps to do the faster scale up as well.
Very important other point is the ability to drive throughput improvements. CAM manufacturing is capital intensive, as you know. And thus, if you have an asset intensive industry, what you need to do is ensuring you have a high utilization and you need to make sure that you're sweating your assets. And the best way to sweat your assets is increasing your throughput.

If you have your linear design, if you increase your throughput of one step, you're immediately - you have to do something on the other steps as well. We can do that very easily in our modular set-up. So we improve the throughputs of our firing. And that already gives us immediately additional capacity as well. That's one of the reasons why you see our capacity has increased marginally in Asia already through these throughputs improvements.

Avoidance of bottlenecks is also important to make sure that if you have issues in your line - and that's also when we talk about the maintenance area as well - we keep on running the other process steps. If there's one disturbance somewhere in the line, in a linear setup, you stop your whole line. With us, we can keep on running and resolve those issues as we go.
Same for maintenance. We can take the blocks out as well.

Another one is the control of the product purity. And this is, again, quite important. We do checks after each discrete process step. It's easy for us to do. And thus, we can control the quality very well. In that sense, and understand the pickup if there would be an issue, we can say it's isolated to this piece of kit. And let's understand what is the issue there as well. And that's a great benefit in terms of troubleshooting when we commission these plants and when we run the plants as well. And the last one is future and current and future chemistry, as already explained it in this area as well.
So high utilization, very important. High efficiency scalability and being very cost competitive is the key outtake of our design.

We continue to drive our efficiency from a CAPEX point of view, but also from an OPEX point of view. And for us, digitization is a key area of that. I think we are in a unique position that we have process data, process knowledge. But we're also building new plants. And with the new plants, we can install the latest digital technologies. But also, we're part of a bigger company. So we can use the technology stack that we have developed at the corporate level, and we implement it directly in our facilities as well.
So our digital strategy is about combining the physical world with data and intelligence. And we do that quite effectively. We are focusing a lot on automatic and real time data capturing to ensure we can do intelligent and remote process steering.
The modular design has a little bit more logistics involved. But we're mitigating that by automating those movements as much as we can. You will see that today as well.
Analytical labs is also quite important. We do a lot of sampling. And we are driving a strong push there in robotization.

One of the key and most exciting bits is looking at the process data that we're collecting and the product data and leveraging that in the future as well. And with that, we can do dynamic process steering. We can have it supported by machine learning as well to

have improved decision making, improved yields as well in our production process and further increasing our utilization in that area as well. Maintenance, I think, is quite a common topic to drive this.

And the last thing is around scheduling and production. We do that to maximize, again, asset utilization. But also, we do that to minimize our energy use. So we have ovens. We need to make sure that they continue to run. So scheduling to make sure that we are optimum from an energy use is also something that is quite important.

Last thing, we obviously are also supporting our people with decision making with that data. Driven by mobile solutions and onboarding, we continue to use augmented reality and virtual reality in that area as well.

CO2 footprint. Yesterday evening, there were already some questions on that. We have a strong drive to reduce our carbon footprint in precursor and CAM manufacturing. We have committed to these targets at group level. We are driving those targets as well at our level. So we want to reduce by 20%. We will reduce by 20% by 2025. We'll be net zero latest in 2035.

So how are we doing that? Two main levers, energy efficiency - this is where I'm pushing my team the hardest. Why? If you save energy, you save costs. So this has to be the number one area that we're focusing on. We have a strong program to reduce the energy intensive operations.
Two examples here, heat recovery for our ovens. It's something that we have implemented in our operations. Heat pumps for low temperature waste heat. This is also a classic topic that will drive that. But there's many more examples of that. We're looking to further reduce our steam usage, for instance in China, to help us improve our energy efficiency.
And then energy decarbonization. We've signed four PPAs already in Kokkola and here for Nysa. So we're fully covered from a green electricity point of view in our operations here and in Kokkola. And we'll start with the green electricity in Canada from the start of production.
But let me explain to you that this is a pretty hard target. And why? Because we obviously are increasing the volume that we're producing. So 20% seems like an OK target. But if we look at how we increase our volumes, it's actually, let's call it business as usual, we need to reduce by 80%. So how are we doing that to make sure that the new operations are net zero from the start and working very hard?
And also decarbonization, our electricity in China and Korea. We're making great progress in that area as well.

Last thing I want to talk about is creating a winning team. And this is something which is very important in this industry. And I'm very proud. And I'd like to thank my team and will continue to do so, all the work that they're putting in. Very important that we have a strong integration between operations, engineering, and process tech. If they're operating as a silo, your factory won't work. You won't be able to commission it.
So making sure that we're fully integrated it into that is super important. We have more than 2,000 men years of experience in process tech.
So we have a very, very, very strong basis, not something you can just get there. And I think this is where we're also unique and are different. We've been doing this for 25 years. We've been building up these experts. They're based in China. They're based in Korea. They're based in Belgium (in Olen). They're based here in Nysa. And we recruited

the first people in Canada already. So this is a key capability that we have. 20% of the managers have a relevant PhD in that area as well.
And we combine this with external hires with transferable skills in continuous improvement, in project management, engineering, but also in digital and CAPEX procurement, a very important lever to further improve our CAPEX density as well.

What is also important to say is we have a longstanding experience in how we are building our factories. So we work very closely with G.S. and his team. When we develop the products, it's an integrated approach between product and process management to make sure we have the optimum blend of the two.
Once we've done that, we define process design criteria. And then there is an intensive process with engineering, but already with CAPEX procurement to make sure that we're buying the best available kit and we're developing a plan.
We go from basic engineering to design engineering. And then when we're building the plant, we're using contract, EPCM contractors, to help us design and build the plant going forward as well.
So we have a process which is very well developed and fine-tuned over the years as well.

The last thing that we are focusing a lot on is vertical start up to make sure that we're thinking through, before we start up the plant, what could go wrong? What failure modes could we have, and how can we prevent that as well? So a vertical start up is something which is very important for us as well.

Almost at the end of my presentation, before I hand over, just the key take-aways of my presentation.
More than 25 years' experience, and I hope I've been able to demonstrate that as well. And Nysa is a good example of how we've implemented all of that experience in our facilities.
We know we understand the complexity of precursor manufacturing and CAM manufacturing, and we continue to drive this and improve our performance of these facilities as a relentless drive to increase throughput, to increase the efficiency of our operations.
We have a global capability. We operate in all the areas that matter. So we understand what's happening in China. We are one of the few that goes to the China battery fair and really understand what all the equipment suppliers are doing over there.
Same in Korea. We're very close to everybody in that area and implementing that here in Nysa.
We are driving process innovation, very important to improve the CAPEX density and the OPEX density in your operations as well.
We can scale our facilities. We have the ability to ramp it up globally as well. We have a local for local footprint that helps us to be present and to have [inaudible]. And we have a very strong team of experts who are driving this.

And lastly, our winning operations strategy. We are driving operational excellence very, very, very, very hard, very important in our industry, given the high CAPEX intensity. We are delivering those expenditures on time to our customers and have it underpinned by a digital transformation.

And now I would like to invite Dariusz to the stage and talk through how we've implemented in Nysa. And then we'll go to the visit later.

Dariusz Jurczak, Managing Director, Umicore Battery Materials Poland
Thank you, Michiel.
Good morning. I would like to introduce you to the unique visit in Nysa in the very short time. But before this, I would like to give you the snapshot of what we are doing. How did we establish the operations over there?

So first of all, again, this is the first cathode materials of Umicore in Europe. And we are only one. So that means there is no one within the industry, any other which established the Gigafactory for this region.
Why we would like to be in Europe? Because we would like to be very close to the end customers. We would like to also synchronize supply and demand. We would like to be short in the delivery to the final destination.
So in 2018, the decision was to go to Europe. So that means 2019, we make it a grand opening. And then we were designing this modular design. We were also taking a lot of learning from the Asia plant to make sure that the setup which we are going to build is the proper one, proper validation, proper check.

So we took a lot of expertise across the different departments to make sure that we are establishing the site itself with all of the system processes, qualification. So because we are going to run for the long journey.

So we start now going from the clouds into the execution. So following the operational strategy, which was mentioned by Michiel, now I would like to show you a bit more what we have on the ground.

So before we will do it, let's have a look, first of all, for the first construction journey which we had in the first two years.

Video playing

Dariusz Jurczak, Managing Director, Umicore Battery Materials Poland
So after the first construction period, we established the backbone. So you see the slide from - you see the outlook of the 2021, where we start with the critical elements we call the backbone, which we can develop and then future expand.
So of course, what did we implement, starting from the raw materials, high storage, and finished goods. They also have a certain connectivity for the flexibility of the people to be moved from the one warehouse to another one.
And then we had a building which we installed as a first one. We call the pre-treatment, where we are mixing all of the products, all of the raw materials. You will see this, of course, during the site visit.
Then in the middle, we make the first firing process. So we put over there the ovens. And then after this, we also have a post-treatment. You see over there one in the top, the post-treatment buildings, and another one between the office reception and the firings and other post-treatment buildings.

So we kind of create the first production floor with the new modular approach, with the opportunity to grow up to add additional technology and buildings as required due to the capacity expansion.

And top of this, also, we bring the intermediate storage. We also took, also, the central maintenance teams. We put also the wastewater treatment plant. And then also what is important, the offices, the lab, and the operation.
So for example, we bring all of the buildings. We bring the technology. We establish the full commissioning. So we pass through the critical milestones. And then from that stage, we are capable to produce the finished good products under the quality restriction.

So a bit more, almost two years after, as you see on this slide, we are expanding. So we are expanding from the left to the right, so more to the up. You already see we are adding the additional pre-treatment buildings. We are adding also in the middle the new furnace buildings. So we had in the past just one, but currently we already have additional two.
So that means over there, there already is existing the technology, which we are qualifying and also start using them.
And then the post-treatment, we had two buildings. Today we are adding additional four, where the two or three today is almost finished.

So you can see we are expanding with the capacity for the site because the Gigafactory, that means we are going to have a lot manufacturing activities over here, which is maybe not visible, in the top. Already we plant the foundation. So we are going to extend also even more.

So as soon as I have approved evidence with the key customers, we are going to make the new construction site. So we are extending the maintenance, we are extending the warehouses, the work in progress. So continuously we are going to grow up according to our operational strategy.

So even within the last two to three years, the team was also recognized on the local market, which was also nice recognition for the local team. So we received a few rewards.
One of them is on the left, the Program Leaders of Social Responsibility. As we are bringing a lot of new commerce, a lot of new people, talented one with the expertise, the local market recognized we are creating the good foundation for the work for our employees. They are on the site, which is developing. They have a lot of opportunity for the innovation. They have a lot of opportunity for growing with the either individual carrier.
We are bringing the digitalization. We have a lot of SCADA, MES system. So it's a good place to work for the people and we are very happy that this was really recognized and rewarded from the outside the Umicore boundaries.
Another one we received in the beginning of this year, the Business Award of the investment. So that means within the economic zone, the biggest one in Poland, Umicore from the 300 different companies was recognized top 20. So that means we are investing, we are developing the region. So we are highly visible on the market and which is also nice because we can also brand the technology which we are bringing not only for Poland, but of course we are going to supply to Europe.

And the last one also from this year, we received from the national level, from the Minister of Development and Technology, there was the category of the Leader of Cooperation. So what is important, our DNA is we are working not only with the customers, we are also working with the suppliers, we are also working with the service

providers. We are socially responsible. So that we are cooperating with the municipality, we are cooperating with the different ministry, we are cooperating with the, for example, Belgium embassy. So we are highly visible, you will in the region via the different forums. So we want to really be kind of very, very active with the cooperation and this is something what Umicore want to do.

And top of this, as Michiel already mentioned, we are creating the winning team. So we recruit the people by the right selection. So we put a lot of effort to make sure that we are bringing the people who has a positive insight, positive attitude. They want to learn, they have a certain expertise. We are happy to bring them over. We are able to share the experience, take the learnings. So those teams are building the site. So they are qualifying, they are taking the new opportunities, as was mentioned by Michiel.
We are digital driven, we are also looking on the innovation, on the new technology. So very, very important is to have the right people. And this is the, maybe balancing, life work balance, right? So we are trying to also create the one-spirit team. So we are trying to socialize, we are trying to also make sure that the people really work together.

And top of this on the, our plot is a big plot, 130 plus hectares. So today we are developing the North plot, where on the South plot, we are going to have the new operation.
So Umicore make a joint venture with PowerCo. The new company which was established, call is IONWAY. So IONWAY is also the cathode materials production.
So our aim is to support them with the start-up, to make it a transfer of the tech knowledge. So the same as we received from Asia, now we are going to also support the new operation of the cathode materials over there.
So that will be our neighbors. So we have been very closely working with them. They are going to start the construction very soon. And also we are going to bring the also certain expertise and they carry over to them.

Another one, Nysa, as we are the new facility with the new outlook, with the new system, the schematic how we are going to work, we are also serving the blueprint for Canada. So our learnings, our opportunities, what we have, whatever we can improve, we already carry over to Canada plant.
And of course over the time, we'd be also supporting them. And of course we'll be learning from them in the future. So we are creating kind of atmosphere, best practice to share and the support, not only local, but also the globally.

On the safety, we'll have later on a short video, but before this, what is important, site in Nysa, we are also operating under certain restrictions from the security, access control and IP. So that means we create a special zones where the people can have access. So that means we are protecting our technology, via the different accessibility to the database, but also we create the zone where the people can go or cannot go due to the fact that the technology which we are bringing are very sensitive elements and we want to make sure that we are capturing them inside and they are not going to be disclosed on the market.
So all of the access control, the special system, the positive access monitoring, those will be highly visible during the site visit.

Where we are going to, what we are going to see today? Today is a kind of layout, but of course during the tour, I will guide you through with my colleagues.

We'll start with the lab first, we go through the operational kind of buildings where everybody who is going into the operation, they need to pass through all of the security checks and so on. Then we will visit the warehouse, going to the pre-treatment, firing process and also the post-treatment.
Right, so that will be more or less one and a half hour tour where we can also give you the opportunity to explain how we are operating this modular concept.