BATTERY & STORAGE PODCAST: REMAINING INNOVATIVE IN THE BATTERY STORAGE SPACE WITH ELECTROVAYA CEO DR. RAJ DASGUPTA
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Bill Derasmo:

Hello and welcome back to the Troutman Pepper Battery + Storage Podcast. Today my guest is Raj Das Gupta, who is the CEO of Electrovaya. Welcome to the program, Raj.

Rajshekar Dasgupta:

Thanks so much, William. So good to be here.

Bill Derasmo:

I'll just give you a quick introduction and then I'll let you expand upon that. I know that you've been with Electrovaya for over 10 years, you've been involved with every aspect of the business from cell manufacturing, engineering activities and business development. You're currently responsible for the company's overall technology and business development functions. You attended Imperial College in London, MIT and the University of Cambridge where you received your Doctorate in Material Science. Impressive background. I guess my initial question would be, so how did you get into this space generally, the battery space?

Rajshekar Dasgupta:

Electrovaya was founded by my father and close family friend Jim Jacobs way back when. So Electrovaya has existed before I joined the company. That said, way back when I was interested in looking at different careers, I did a placement at MIT when I was an undergraduate, we were actually making solid-state batteries, this was way back in 2003. I thought it was super exciting so I decided to... Actually, at the time I was actually almost considering becoming a lawyer, I was thinking of doing engineering undergrad and looking at potentially going to law school later. But I changed my mind after that placement and I applied to grad school in material science, specifically at MIT and other places and the rest is history. So I worked on battery related materials as part of my PhD and joined Electrovaya afterwards. So fundamentally, I have a very strong interest in the research side of things, but also in everything that goes with batteries.

Bill Derasmo:

Well, thank goodness you escaped the fate of a lawyer, that would've been terrible. That's a interesting story and sounds like you've had a passion for batteries, energy storage for a long time. Looking at Electrovaya and folks can go to Electrovaya.com, it's V-A-Y-A at the end .com. And that's what I did as part of the preparation for this and going off of the corporate presentation that's posted on the site, I just looked at a lot of different things that you have in there and it's interesting because you guys, and correct me if I'm wrong, it sounds like you have an interest in both mobility and the stationary, what we would call stationary applications. So, the EV type of applications, but then also perhaps for print scale storage or onsite storage

for commercial industrial customers. Perhaps you could expand upon that, just let me know what the company's plans are in those areas?

Rajshekar Dasgupta:

Just stepping back a second here. So, Electro Vaya has been in the battery space a long time, and this is an industry which has, as you may know, very strong, large Asian conglomerates dominating the industry. And as a result, you have to remain innovative or you die. And that has been our direction for the whole time I've been with the company. If you look back well over a decade ago, we were heavily involved in the electric vehicle space. We were supplying Chrysler for their plug-in hybrid battery program, we were supplying Daimler for their E-smart vehicles later than that. However, what we were finding was that this was an industry that was going to be extremely cost-competitive and one where we may not be able to compete on price alone. We are a technology company, so we wanted to be able to differentiate ourselves and sell our products at a relatively healthy margin.

And so, we developed, and we'd already developed this to some degree, was a very safe, high cycle life lithium-ion cell technology. It's a cell technology that gets two to three times the cycle life of typical lithium-ion batteries used in the automotive or grid-storage space and it utilizes full ceramic separators, which improve the safety quite dramatically. We looked at what applications would place a premium on these types of technical performance attributes and we came across material handling, which is not something that you think of at first because it happens behind closed doors and you don't usually see the vehicles.

But there are thousands of these electric material handling vehicles operating at Fortune 500 companies, at your Walmart or Amazon distribution centers, and these vehicles operate 24 hours a day at these types of sites. And so, they're really using that battery. When you compare it to an electric vehicle application, I don't know if you drive an EV, but I do and I drive it probably one hour per day and I'll do one cycle on that battery a week. The material handling applications will do one or two cycles per day. Order of magnitude, heavier usage and that's where they can take advantage of that cycle life. On the safety side, these vehicles operate within buildings, so safety is more critical to these applications than your typical EV applications, so it was a very good fit.

Bill Derasmo:

Just jumping in there. We're talking about a segment which I don't think we've ever talked about and we're into our third season on this podcast and that is what you said, the material handling aspect of operations. And, in particular, I think something that jumped out at me was you talked about ceramic separators. These vehicles, I'm assuming operate in spaces like warehouses and if you have a ceramic separator, I'm guessing that your safety experience, your safety rating is going to be much better?

Rajshekar Dasgupta:

That's correct. Just describing what the separator is, all your lithium-ion batteries have separators inside, these are typically polymer separator membranes and they keep your cathode and your anode apart so there's no short circuit. What happens when batteries get too hot is that separator material shrinks. So, if you've ever taken a lighter to a plastic bag, you'll

notice that instead of expanding, which is what your instinct may be, it shrinks. And the same thing happens with your battery separator materials. They actually deform at relatively low temperatures. The polymer separator membranes will start to shrink at about 100 degrees Celsius and your high-end ceramic coded polymer separator membranes maybe at 120, 130 degrees Celsius. What happens when they shrink is quite catastrophic. Your cathode and anode are no longer necessarily apart and you get a short circuit and what the battery industry would refer to as thermal runaway and what most other people would call a fire.

Bill Derasmo:

Right.

Rajshekar Dasgupta:

So that's something that we can avoid or significantly mitigate with the use of full ceramic separator membranes, which is what Electrovaya has, I would say, uniquely commercialized. And we've been very focused on that technology for several years, there are some difficulties in using ceramics in your lithium-ion cell, mostly to do with how you manufacture the cell because ceramics are a bit delicate and brittle. But the end result, if you can manufacture it is you get a cell that is much safer and something that for myself where I care a lot about everything that we make, I can sleep at night not thinking about a battery catching fire.

Bill Derasmo:

Sure. And just for the audience, I'm not an expert in this area, but my understanding is that ceramics were key to the space program and aerospace applications. I don't know if you could just talk for a second, we can geek out on material science, which is your background?

Rajshekar Dasgupta:

For sure. The space program, for instance, on the shuttles, ceramic tiles were critical for preventing overheating of the core spacecraft parts. So as the shuttle would have re-entry, the ceramic tiles were a critical component or protecting the shuttle from the high temperatures that resulted from the friction when the shuttles came back to earth.

Bill Derasmo:

And I didn't mean to divert the conversation into the space program, but I just thought it was interesting that one of the ways that Electrovaya can differentiate itself is by the use of ceramic separators and I had somewhere in my memory banks that ceramics were really important to the space program. So, I just wanted to ask about that. But in terms of your company and you've got a slide here that talks about infinity batteries and solid-state batteries. I was just wondering if you could explain to the audience what the difference is between those two subject headings?

Rajshekar Dasgupta:

The infinity batteries is what we're producing in relative scale right now, which is what I described earlier, that ceramic separator is the core differentiator along with our unique electrolyte. And that's providing those lithium-ion battery products with better safety and better

cycle and that's what we're applying to those heavy-duty applications. Solid-state batteries on the other hand is what's referred to often as the holy grail of battery technology. And that's because it enables much higher energy densities, you can potentially double the range of your electric vehicle, you can enable electrification of new transportation methods like electric aircraft, the list goes on and on and on. That said, there are no commercial room temperature solid-state batteries today and there are various reasons for that. But there are a lot of companies now working on it and a lot of researchers, a lot of smart people around the world working on it.

We also have a significant solid-state battery program and I'm very bullish on our development there. The solid-state battery program utilizes a lot of what we already know. It would be utilizing a ceramic separator membrane, the main difference is this ceramic separator is ironically conducting. It enables you to significantly reduce your liquid electrolytes and also enables you to use pure lithium as one of the electrodes in the lithium-ion battery. And that's really what provides that significant boost to the energy density. Right now, we have a dedicated team and a dedicated site working on this technology and we're getting some pretty exciting results thus far.

Bill Derasmo:

In terms of looking ahead, it sounds like you've got a foot in both camps, but in a good way. And what I mean by that is a lot of times in this space we talk about, as I said, the sort of e-mobility, you've got the mobility applications and then you've got the stationary applications. I would think something with the long duration obviously has advantages for the mobility applications, but the energy storage systems where you could put a battery on the commercial industrial site or even selling the output to a distribution company or utility, I think that you've got a range of opportunities out there. And so, looking ahead, where do you see your company going or where do you see your company concentrating right now?

Rajshekar Dasgupta:

On the stationary energy storage side of things, I personally believe our Infinity Battery technology is the ideal technology for that industry and there're several reasons for it. Number one is energy storage. You want to utilize it as much as possible, you want to charge and discharge that battery. The more times, the better you are utilizing the technology, the more you're monetizing it as well. And I think with our Infinity Battery technology, we definitely provide, not necessarily the lowest upfront costs, we definitely don't do that, but we will provide the lowest cost of ownership over a period of time. And if you want to refer to that as cost per cycle, we'll also be the lowest cost per cycle technology out there.

So, I think we're actually very well positioned technology-wise for that segment, that set us as a company is not so focused on it because of the demands coming from both the material handling and the heavy-duty vehicle space. But there's another way to look at energy storage. If you look at some of these warehouses that we're deploying batteries, we're deploying maybe four, five megawatt hours of energy storage within some of these buildings, which is significant. It just happens that those batteries are within material handling vehicles, it's just a matter of time before... Actually, we're already implementing some of this right now, we're implementing certain demand response technologies and potentially battery to grid capability there as well, which in essence enables both a vehicle application as well as an energy storage application.

Bill Derasmo:

Let me pause on that for a second. So, you mentioned demand response and you're getting more into my world where I'm usually sitting. Talk about Electrovaya's potential use in a demand response scenario?

Rajshekar Dasgupta:

Stepping back to that warehouse again. So, let's say you have four or five megawatt hours of batteries within that building and each unit has a charger with, let's say, 20-kilowatt capability and you've got a hundred chargers, a hundred times 20 kilowatts, you've got two megawatts of load there. We can adjust that load demand according to a utility signal for instance. We can tell our batteries, don't charge or do charge, we can tell our batteries to prioritize charging at off-peak periods, there's so many things that we can do on this front. And because Electrovaya has a significant in-house software firm or team, we can develop these algorithms quickly and it's something that we are working on. So, with some of our big customers, they are looking for this type of capability, especially when they're looking at retrofitting sites maybe that have older infrastructure or are in cities that have electricity limitations or high-cost electricity, et cetera. There's so many different possibilities.

Bill Derasmo:

Sure. Well, here in the states, you've got the regional markets that are operated by what we call either RTOs or ISOs and you've got the Federal Energy Regulatory Commission for, I think, encouraging demand response and FERC issued order, I think it's 2222, which is this distributed energy resource aggregation type concept. And so, I just think you're going to see continued growth in that area. I think that this summer, I'm sure the regional markets relied upon demand response in part to get through some of the high temperatures that we saw.

I think that, that's going to continue to be an area of growth for these regional markets, I think you're going to see some opportunities there. I would ask this, in terms of where your company is in terms of attracting investment, I'm sure you have to talk to the investment community from time to time. What would be, I hate to use this phrase, it's such a corporate speak phrase, but what would be your elevator speech? Let's say I'm a private equity guy and I meet you at a conference and I hear about Electrovaya and I'm interested in your technology and your approach, what would be the conversation? What would you say to me to get me more interested in investing in your company?

Rajshekar Dasgupta:

I would say we're in this sector, which is clearly critical to climate change mitigation and clearly is strategic in nature in the sense that we need to develop North American supply chains, which can provide an alternative to some of these Asian dominating industries. So that said, Electrovaya specifically, we are highly innovative, we have a lot of IP, we're also very competitive in what we call these large niche applications like material handling, heavy duty trucks and buses, as well as potentially this energy storage angle here. We continue to provide our customers solutions which provide the commercial benefit, at the same time, Electrovaya has consistently sold our battery solutions at relatively high gross margins. This is an industry where there's a lot of companies losing a ton of money with the hopes that they eventually

cross that bridge. We are going to cross that bridge much earlier, we're tracking to do so in the current quarter, we're a very exciting and I would say honor valued story.

Bill Derasmo:

What I take away from this conversation is that you guys, you mentioned your IP portfolio. What I would say is that you guys have a nice story to tell in terms of the ceramic separator, in terms of the segment that you've been able to target so far and that you've been successful for. And that's the material handling, the forklifts, the machines that you would use, as I say, inside a warehouse as examples, but not exclusively. Those are very good differentiators for your company and, I think going forward, it sounds like you've got a range of opportunities that you can go after beyond that. But the recent passage in the United States of the Inflation Reduction Act and I know it's so recent that we're all still trying to figure it all out, but I would ask if you see that law as... I would assume the answer's yes, but I would just ask you if you see that law as creating tremendous opportunities here in the United States and if you guys have given some thought to what those opportunities might be?

Rajshekar Dasgupta:

Yes, I'm very pleased to see that, that law was passed. I think it's strategic, it's going to help the economy and also this great problem that the whole world shares with regards to climate change. So, it's a very good move on behalf of the US government and I think it's going to benefit the local supply chains for the electrification movement, including ourselves. Electrovaya specifically, we are looking to reshore a lot of our manufacturing and that will happen in the US. So, these types of policies are helping to drive that type of behavior in companies like ourselves and I think they're probably others as well. So overall, it's a great move and we're excited to be part of it.

Bill Derasmo:

The reshoring aspect is really fascinating and I understand that there's been a lot of thought given to that for a while now, but this law really pushes that forward in a meaningful way because of all the advantages that you can get from domestic sourcing. So, I think it's going to be a boon to the industry, it's fairly obvious, to the storage and renewables industry. Well, I appreciate the conversation. As I said, it was an interesting conversation for me just to hear about a couple of the aspects, a couple of the ways that Electrovaya can differentiate itself from other companies. I'll give you a last opportunity here, anything else you want to leave our audience with or resources that they could take a look at to learn more about your company?

Rajshekar Dasgupta:

The only other thing I'd probably mentioned again, is on what we come to offer. We have these commercial scaling applications right now today, which is based on our Infinity Battery technology platform. That said, we also are very excited and I believe we will commercialize the solid-state battery platform in the coming years and that is also a significant game changer for us as a company. So, it potentially brings us back into the electric vehicle space with a superior technology. Again, we don't want to be the lowest cost solution, we want to be the best solution that fits our mandate there. I'm very excited about what's happening in the industry overall and with us specifically, things like energy storage. We have to be, as a society, much

more nimble with respect to things on the grid, for instance, you mentioned the heat waves affecting hydro and other generation sources and energy storage is going to become more and more critical to keeping that resiliency in place.

Bill Derasmo:

Well, recent trade press reports in terms of California getting through a tremendous heat wave, some of the folks in California are saying, "Well, it's because of the storage." They have installed, and I'll have to get the numbers for our next episode, but they've installed a significant amount of megawatts on the system in terms of storage capacity and that was apparently what got them through according to some officials. So, it's interesting, California is probably ahead of some other regions, but I know the installations are happening all over the place in all the regional markets. And that will likely accelerate as the continued transformation of the resources on the grid, as that continues to progress. In any event, it was great to have you on the program, we want to keep in touch with you as we go forward, it sounds like you've got a lot of exciting possibilities going forward. Thanks for being on.

Rajshekar Dasgupta:

Thanks so much and it's been a pleasure speaking with you.