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Connecting for positive change.

Steffan

Hello, hello and welcome. Amazingly, we are up to episode five now. So, thank you for joining us again and welcome to the HydroGenerally Podcast Series, which is brought to you by Innovate UK KTN. My name is Steffan Eldred, and I work in the Clean Energy and Infrastructure Team at Innovate UK KTN. Just to remind ourselves, we've heard about how hydrogen is produced, where it should and could be used and we've now dived into specific sectors so far of aviation and marine. Before we get into today's episode, just a quick summary again of the podcast and the network. So HydroGenerally, the podcast series, is the voice really of the Hydrogen Innovation Network. We look at applications, opportunities and challenges of the hydrogen economy. We want to help enable local, clean hydrogen uptake at scale, and costs, so comparable costs and try and help find novel solutions to aid this. So if you haven't already, then please do go to the Innovate UK KTN website, through the link in the description and sign up to receive newsletters and updates. I think you can pretty much just google KTN and hydrogen and it will come up. You will also find previous and future episodes of the podcast there. So following on from aviation and marine, today we're going to continue our tour of different sectors and look at glass, glass production. So helping me out today is my colleague, Neelam Mughal. Hello, Neelam, can you introduce yourself and tell us about your role? And, of course, just as importantly, introduce today's guest.

Neelam

Hi Steffan, yes, of course. Hi, everyone. My name is Neelam and I look after Advanced Materials at KTN. So this covers a range of materials for high tech applications such as energy storage, materials, the space and metal materials. I also work on the ISCF Transforming Foundation Industries Challenge. Over the past two years, this TFI Challenge has delivered a series of activities to enable the sustainable future survival of these industries within the UK through energy and resource efficiency improvements. These industries are the metals, paper, glass, cement, ceramics and chemical sectors. So on that note, we're really lucky today to have Rob Ireson with us to help us understand the opportunities and challenges facing the glass sector. Rob is Innovation and Partnerships Manager at Glass Futures. So over to you, Rob, please, could you introduce yourself and a bit about your role?

Rob

Brilliant. Thanks, Neelam and thanks very much for inviting me to join you. It's a great privilege to be here with you. So, as Neelam said, my name is Rob Ireson, I'm the Innovation and Partnerships Manager at Glass Futures. So I had all of the technical and research activities across the organisation, my background is material science and metrology. So I've worked in the steel industry. Then I've spent the last ten years working in the glass industry and most of that time has been spent working on industrial research, particularly in terms of areas such as looking at making industry more sustainable. For those who aren't so familiar

with Glass Futures, Glass Futures is a relatively new organisation, we have established ourselves to be the global centre of excellence for glass. So, our core remit really is to drive new developments and research across the glass industry, with a real focus to try and make the glass industry more sustainable. And in terms of how we want to do that, we want to really provide a platform whereby we can really take technologies from lower stages of research, and we can fast track them through to the point where they can be commercialised and deployed in industry. The way we want to do that is by first of all providing the research infrastructure that's required to do that. So we're currently in the process of building a thirty tonne per day glass pipe pilot line facility in St. Helens in the UK. The idea is that this will be effectively, a mini glass production line where people can come and try new technologies. In addition to that, we're looking to have a host of other research equipment, such as a multi-fuel combustion testbed, that we've developed at the moment, that can trial and benchmark different fuel technologies like hydrogen against other technologies like natural gas, electric melting, and biofuels.

Steffan

Great. Thanks. Thanks, Rob. really comprehensive and thanks, Neelam great, really appreciate you joining us today. Let's kick off with a question or two and see where the conversation goes. So, being completely honest, I'm very far from a glass sector expert. So Rob, do you think you could give a quick overview of where you think the opportunities for hydrogen in glass production lie?

Rob

Sure. Well, for those who are not so familiar with glass manufacturing, basically, at the heart of the glass manufacturing process, is the glass furnace. So this is a massive refractory box that can hold upwards of a couple of thousand tonnes of molten glass at any moment in time. And these furnaces require as you can probably guess, a huge amount of energy to melt the raw materials, and then to condition the glass to make it homogenous and to get rid of all the little bubbles from it. So we get the beautiful glass material that we all love to drink out of and put in our windows in our homes. So the main opportunity, I think, that hydrogen has to offer the glass industry is really in that that glass furnace, where around 70 to 80% of the energy that's required to make glass is used. Nearly all of that energy at the moment is supplied by natural gas, there's a bit of electric melting, but most of it is supplied by natural gas, that is a fossil fuel. So I think there's a massive opportunity for hydrogen to be a substitute for that natural gas. I think that's the main reason, the main opportunity that hydrogen has for glass industry. There are also a number of other downstream processes, which could use hydrogen, such as in the annealing processes and some of the kind of cutting and polishing processes as well. And although they are probably smaller, or they account for a smaller percentage of the overall energy, I think there are opportunities there, although they might be more challenging to exploit.

Neelam

Thanks for that, Rob. So I'm sure that with all the opportunities you just highlighted there'll be plenty of challenges as well. Would you mind sharing your thoughts on these?

Rob

Yep, sure. So unsurprisingly, there are going to be a lot of challenges. For example, the way in which hydrogen combusts is very different to the way in which natural gas combusts, you

get a very different type of flame. So for example, a hydrogen flame has a much lower emissivity, than natural gas flame. Which means that actually, if you look into a furnace that's burning hydrogen, you can barely see the flame at all. Whereas in a normal glass furnace, you get a beautiful bright, yellow/orange flame that you can look at. So this has challenges. So for example, it's much harder to optimise the flame dynamics. So the shape of the flame in the glass furnace is really critical. In terms of governing, for example, how the heat is transferred into the glass and how the glass raw materials melt. So, that's one challenge. There's also, another challenge of having a, what we call a low emissivity flame that's virtually invisible, it also affects the actual heat transfer itself into the glass. So the fact that a normal natural gas flame is nice and yellow-orangey, those wavelengths of infrared light and visible light, are actually easily absorbed by the glass. Whereas the fact that the hydrogen flame doesn't have as much of those wavelengths, does affect the heat transfer into the glass as well, which is something we're currently trying to understand how that might impact the glass process. Other challenges are linked to the fact that hydrogen flames tend to burn at a much higher temperature than natural gas flames. So this means that there's an increased risk of having problems with NOx emissions. So the amount of NOx that's produced by a flame goes up significantly as you go to higher temperatures. So hydrogen flames are known to have higher Nox, that's something which the industry is looking at addressing. Then there are other challenges. So, the atmosphere that's generated when you combust hydrogen is very different, again, to natural gas, you pretty much just get a lot of water in there when you combust hydrogen and that just really affects the atmosphere in the furnace. So that can have quite interesting effects. It can do things like it can affect the glass itself, because the molten glass can absorb a little bit of that water. It can also mean that some of the elements in the glass particularly elements like sodium and sulphur, they can be volatilised more easily. And again, when they get into the furnace atmosphere and when they mix with the moisture, the higher moisture content in the atmosphere, again, that can result in higher degradation and wear rates of refractories. So that's something else which the industry is again, is aware of and is looking at trying to find solutions to address. Then there's issues more on the supply and economics side, that are going to be a challenge. So already mentioned that a glass furnace is is big, a typical glass manufacturing site they can produce between eight hundred and sixteen hundred tonnes of glass per day and that can use up to two gigawatts of energy. And when you translate that into hydrogen, that can equate to upwards of sixty tonnes of hydrogen, which if you convert that into hydrogen trailers, could be upwards of one hundred trailers per day, maybe even twice that for some of the bigger sites. You can see that just the logistics of getting the hydrogen to the site again is going to be a challenge for the industry.

Steffan

Yeah, definitely. I think it's really interesting hearing you talk there, because things like, you know, the fact that the flame is invisible with hydrogen, for example, I guess, those are common challenges across perhaps some other energy intensive sectors, cement and things like that will be dealing with the same issues. But when you get into the moisture, ultimately getting into your end product and the impact that can have, that's obviously very specific to glass. Yeah. Just on a different note then, what terms of sort of motivation and drivers, you've, obviously, a lot is going on around hydrogen and how it can work for the glass sector. So what would you say are the sort of key drivers behind that, you know, that sort of hydrogen adoption, going forwards?

Rob

So I think the biggest motivation is the motivation for the glass industry to decarbonise itself. So there is a real interesting keenness across the whole of the industry now to find ways to decarbonise its processes. And hydrogen, I think is an obvious candidate to do that, I think mainly because it is a gas. So therefore, there are a lot of parallels in terms of how the current infrastructure can be used with hydrogen. Because although there's differences between hydrogen natural gas, there are a lot of similarities as well. The fact that hydrogen can be transported via pipelines means that if the current natural gas pipeline infrastructure can be converted, to be able to hold hydrogen, obviously makes it very straightforward to get the hydrogen to the site, we don't have to rely on putting a lot of extra cabling and substations that we would need if we wanted to switch to electricity for example, we wouldn't have to have the additional traffic, that might be associated with liquid fuels, like biofuels that the industry is also exploring. So I think that's one reason why the industry is looking at it. I think the other one is because hydrogen is one of those fuels that has the potential to be truly green. So if you can create the hydrogen via electrolysis to make green hydrogen, then it is very clear that that that hydrogen is truly green, there's no carbon emissions linked with it.

Neelam

Thanks for highlighting the external factors that are at play, Rob. So I'm just wondering, internally, how do production professionals or glass operators actually view this sort of hydrogen adoption and transition? Because I guess they've had so many years of refining their plants that run on natural gas? But is there a sort of keenness to move forward or was there reluctance?

Rob

I think there is certainly a growing interest in hydrogen as an industry. So it is seen as a fuel that the industry wants to explore, and hopes that it will be feasible in the future. However, I think understandably, there's also some scepticism and quite a lot of nervousness associated with that, primarily because of the the challenges that we've already discussed. But I think there are also concerns over aspects such as the economics of switching to hydrogen. So for example, there's uncertainty as to how the cost of hydrogen will compare to other fuels. There's uncertainty as to how much it will cost to upgrade the plant. Will they have to replace all of their refractories for example? And one of the biggest challenges the industry has when switching to a new fuel is the life expectancy of the furnaces. So a furnace, a new furnace that's been built, basically, once it's been lit and it's been brought up to temperature, which is about sixteen hundred degrees Celsius, then it will continue to operate at that temperature pretty much for its full lifetime, of up to twenty years. So the furnaces that are built today may not be replaced until 2040. And often sites might have most two, maybe three furnaces, a lot of sites will just have the one furnace. So again, they can't risk doing anything that might affect their production, because then their whole site could be out of action for a number of months. So I think, yeah, there are concerns as to how they actually switch when the fuel might be available, as well is another concern. As we know, in some areas, it's likely that there could be a supply of hydrogen within the next ten years. Then there are other areas where it could be twenty or thirty years, if ever, that there might be sufficient volumes of hydrogen to service a glass plant. So, I think those are the main concerns. I would say, despite those concerns, I think there is a real keenness from the glass industry to explore this as an option.

Steffan

Yeah, I think, in any process like this, I think it's very, in our sort of positions, we're obviously always forward looking and looking to that next opportunity and in this case, hydrogen. It's often hard to sometimes you have to remember that the person in charge of production at that plant, you know, their priority is producing the end product, producing a quality product at the right cost or what have you. So it's trying to intertwine that with the forward looking view, and hydrogen in this case is really tricky. I think you sort of touched on timescales, so does the sector have a sort of, I don't know really, a date in mind? When you talked about certainly anything that goes in today might be there until 2040, for example, but is there any sort of a roadmap or something that you're working to?

Rob

Yeah, it's good question. So Glass Futures is actually working with our members to try and put together a roadmap for deploying hydrogen. So there is actually one of the manufacturers that we're working quite closely with, that has expressed a real interest in actually building a furnace that can run off hydrogen. And they're hoping that might be realised within the next 10 years, potentially sooner, if they can get the volumes, they've kind of laid down the gauntlet to the Glass Futures team and the industry to say, look, if you can prove that it works, we're willing to consider putting down a hydrogen furnace. So I think there's at one end of the spectrum companies that are sort of chomping at the bit, so to speak, to get the hydrogen furnace there. I think at the other end of the spectrum, there are probably manufacturers that may be looking at other fuels, say within the glass industry, I think one of the preferred options is a large electric melting furnace, or potentially a furnace fired by biofuels. So, I think probably the message really is that I think for the glass industry, there's probably going to be a range of different fuel scenarios that might be needed to decarbonise the industry, depending on the type of plant, the location and the sort of investment that's available. But I think in terms of when might the first furnace be installed? Well, I think I'd love to see a full hydrogen furnace in the UK by 2030.

Neelam

I think that's an excellent date to aspire towards, there's a lot going on around 2030/2050. So in that sort of sense, is there any support that you'd be looking for? Perhaps from the government to accelerate that progress towards the hydrogen transition?

Rob

Sure. I think first of all, I'd like to stress that the government has been really good in supporting us so far. They've provided a lot of funding through the Industrial Fuel Switching programme, that's helped us to do a lot of the feasibility studies to start exploring how hydrogen fuels compare with natural gas fuels, and start to understand how we design the infrastructure to use hydrogen and how we optimise the hydrogen process, the combustion process and the mechanics around using hydrogen to start understanding how we make that transition. So it has been good so far, I think I would say that that support needs to continue. The next challenge is that a lot of work so far has been done at a sort of smallish scale, the next stage is to trial it at a larger scale, for a longer period of time. So our hope is that when our new pilot facility comes online, towards the end of next year, we can secure funding from the government and hopefully from industry as well, to actually run some prolonged trials, maybe sort of six to twelve month trials, actually in a proper glass furnace environment, to

start seeing how the different bits of the furnace respond when they're exposed to the hydrogen glass melting process for a long period of time. I think that's one area, more support for the technical research that's needed. I think the other area of support that's required is really helping with the economics and the business case side of things. So if, for example, are there ways in which the government can help subsidise hydrogen? Obviously, any glass that's produced has to be cost competitive with sort of competitive products that are produced using natural gas. So there has to be a way that's found to make it economically viable to use hydrogen. So I think and I know a lot of work is going on in that field across the country anyway, but I think certainly if the glass sector can be engaged and involved within those discussions as well, I think that will also be a key enabler to help the glass industry start to seriously consider adopting hydrogen as a fuel.

Steffan

Great, thanks. Thanks, Rob, as you say, there's a lot going on at the moment and certainly a lot of support, you know, we've just had the industrial hydrogen accelerator launched, The Net Zero Hydrogen Fund and actually the business models as well, the hydrogen business model. So all relevant but I think the glass specific view is it'll be really valuable to people listening to this. I should have learned by now after recording quite a few of these but time absolutely flies. So, thank you so much. I think we probably need to start drawing to a close. Thanks, Neelam for joining us to host today. And thanks, Rob. It's been a real privilege to have you here today and learn about the progress Glass Futures and the wider glass sector is making in the hydrogen world. Thanks, everyone, for listening. As usual, any links mentioned today and a direct link to the Innovate UK KTN website will have been added into the description that you've seen for this. Don't forget to sign up to receive newsletters and updates. We've got a couple in the pipeline for you, so I'm not 100% sure which one will come next but we're certainly in discussions about podcasts on hydrogen combustion and then also about hydrogen for heat. So if you're listening to the next one, you should get one of those, so until then, thanks again for following us and goodbye.

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