RioTinto

Transcript

Things You Can’t Live Without

Episode 6 – Alie Ward's Insulated Flask

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Dr Anna Ploszajski [0:00]
There are some things we simply can't live without for our livelihoods, for our wellbeing, or just getting from A to B. But every item that we bring into our lives, however precious or necessary, is going to have an impact on our planet. I'm material scientist Dr. Anna Ploszajski, and on this podcast, I talk to special guests about the one thing they can't live without.

And we take a deep dive with experts to find out the true impact of our obsessions. Joining me today is a Daytime Emmy Award-winning science communicator, podcaster, TV presenter, writer, and food buff. Her comedic science podcast, Ologies, was crowned one of Time Magazine's Top 50 Podcasts. She's a regular face on screen, delighting audiences with science and cooking in equal measure, and she's basically an all-round cool nerd, and believe me, I do not use that term lightly.

Dr Anna Ploszajski [0:51]
It's Alie Ward!

Alie Ward [0:52]
Hello! Thank you for having me, I'm so excited!

Dr Anna Ploszajski [0:53]
Welcome, Alie. It's so lovely to have you here. So, so far on this podcast, I've had guests bring to me electric bikes, prosthetic legs, and the good old-fashioned dictionary to the table as items that they can't live without. But what about you, Alie? What's the thing that you can't live without?

Alie Ward [1:10]
Well, you know, I guess going backwards a step from a basic homeostasis, I can't live without water, which most of us, from what I understand, cannot. For me, a lot of my water drinking is based on having to incentivise it. And so, I cannot live without this particular mug that I carry around. And I get very emotionally attached to mugs. And this has been my mug for the last couple of years. And I don't drink enough water if I don't have it, which could kill me.

Dr Anna Ploszajski [1:42]
Okay. So, it is literally a lifeline.

Alie Ward [1:44]
It's a lifeline.

Dr Anna Ploszajski [1:45]
You would perish without it.

Alie Ward [1:46]
I find every other cup inferior. And so, every time I go to drink water in my house, it's a compromise, unless it's in this cup, which the more I talk about it, the more embarrassing it gets. It gets weirder and weirder.

Dr Anna Ploszajski [2:00]
So your insulated reusable cup is the item that you can't live without, Alie. But to take us through how it came about. Both in the historical sense and the material sense. This episode we're joined by chemist and broadcaster Andrea Sella and Marie-Pierre Paquin, Chief Advisor of Discovery from Rio Tinto. Welcome to you both.

Marie-Pierre Paquin [2:19]
Hi Anna.

Andrea Sella [2:20]
Hi Anna.

Dr Anna Ploszajski [2:00]
So we're going to turn to you two shortly but for the benefit of our listeners, who don't have the privilege of visuals on your beautiful cup. Alie, can you describe this thing of beauty to us.

Alie Ward [2:31]
So, it is a metal cup with a ceramic glaze, I think, around it, but the core is stainless steel and the magic of it is that it's insulated. I drink my water very cold. And, when I really fell in love with this cup was when I had a quick business trip and my car was parked for 36 hours in LA, where it tends to be very hot, and I came back and I still had ice in it with no top and we had a bonding moment at that time. But I hated this cup originally. This was my least favourite cup I owned for a while.

Dr Anna Ploszajski [3:09]
Why? How come? How did you first come about it?

Alie Ward [3:11]
Well, it was a gift. It was a promotional gift on a production I had worked on. They gave one to everyone and it had our names engraved in it, which was very nice. And the logo of the company, it was one of those like swag things that you always feel kind of guilty getting because a lot of times you don't need them. Water bottles tend to be pretty rampant. Tote bags, those kinds of things, pens. But it had my name on it, like laser engraved into it, but they had put my full name, which is Alison, which, no one calls me Alison. Like if my parents call me Alison, I'm concerned. Maybe the dentist and the DMV that's on.

So, it had the name Alison written in it. And so, every time I saw it, I, I felt like I was getting reprimanded. And so, it was in the back of the cupboard and it's not an item you can donate because who wants a mug with someone else's name on it? And I felt bad about it because it's a resource, it's an item. And so, I carved Ali out of the Alison. I was able to take an Exacto knife and carve Ali W, plastered it with some vinyl stickers, and then I was like: okay, now there's a spark.

Now there's some, I guess, some chemistry if you will.

Dr Anna Ploszajski [4:21]
So how long have you actually had it for?

Alie Ward [4:23]
I want to say eight years, eight years.

Dr Anna Ploszajski [4:25]
Oh my God. Okay. That's way longer than I thought you were going to say.

Alie Ward [4:28]
Right. I mean, I'm, I'm, uh, I guess I'm cup monogamous for the long term, but I think I've only been using it for about three to four years.

Dr Anna Ploszajski [4:39]
There was a cupboard period of which we don't talk about anymore.

Alie Ward [4:42]
I think we bonded during COVID. I think options were limited.

Dr Anna Ploszajski [4:46]
Makes sense. Andrea, I'd love to bring you in here. We've talked about mugs keeping things hot, mugs keeping things cold. Can you talk to us about the vacuum flask? Because this is a variation on that. So, give us a bit of the flavour of the history of the vacuum flask. How did it first come about?

Andrea Sella [5:02]
I mean, the vacuum flask is an amazing thing and I have loads of them today. I suppose you'd call it double glazing instead of having a kind of container, which has single wall. So, you have this double walled thing, which has a vacuum, which has an empty space.

The thing is, then you have to understand how it is, that warmth can be transferred from one place to another. So, the first thing is, and this is a law of thermodynamics that was identified, heat energy always flows from hot things to cold. And so, if you think about an ordinary mug, you make a cup of hot coffee or tea and if you hold it after a moment, it's scalding hot, right?

And the reason is that essentially, you know, this whole thing is made of assemblies of atoms, one jostles the next one and so when it's hot it moves more, so it causes the next one to jostle and that causes the next one to jostle, right? And here I'm quite interested by Alie's story about her ice in the cup because she said something about not having a lid on the top and that the ice was still maintained and that's quite interesting because if you have something cold Typically, if you cool things down, they contract, and typically, if you warm them up, they expand.

And that gives you a way of transferring energy around. Because imagine you have some air in contact with the hot drink, well, it'll be warmed up by the contact. And then, because it's now expanded, it then moves upwards. And one of the things that you want to factor in is, you know, if you're drinking coffee or tea, what temperature do you drink it at?

And the interesting thing is that, actually, we drink that in that sort of 50 to 60 degrees celsius

range. And so, these highly insulated cups, if you put the lid on them, you make the tea, you put the hot drink in there, and then you've got a problem is that the stuff is too hot for too long. And so actually people often will take the lid, will take the lid off initially, and then they put the lid back on.

Alie Ward [7:16]
Ha! Yes!

Andrea Sella [7:17]
And at that point, the cooling rate drops off. It levels out. And now you can hold it there for a long time.

Dr Anna Ploszajski [7:23]
Alie, has that answered all the questions you ever wanted to know?

Alie Ward [7:26]
Yes. These are things I think about all the time. These are mysteries of my daily life. I wake up and I confront boggling questions about the very thing I need to survive.

Dr Anna Ploszajski [7:40]
Well, from solving life's great mysteries to, um, to zooming in and, and thinking about the, the physicality of this object, let's get back to the bug and the materials that it's made from. But to take us through the steps that go into sourcing, producing, making that steel for your flask, all those atoms that had to be assembled to create that object. We are now gonna turn to Marie-Pierre Paquin from Rio Tinto, to take us through that. So welcome Marie-Pierre.

Marie-Pierre Paquin [8:08]
Hi Anna. Hi everyone. Very happy to be here.

Dr Anna Ploszajski [8:12]
So, steel is an alloy of iron, mostly, but with a very small amount of carbon in it. And to make it stainless, the special type of steel that we have in our mug, we have to add chromium and nickel to the mix as well. So, there's four elements from the periodic table there, iron, carbon, chromium, and nickel. That sounds like quite a lot of ingredients to have to bring together, to source from different places, and melt together to make this material. So, can you take us through where these ingredients in Alie's mug might have come from?

Marie-Pierre Paquin [8:45]
All of it comes initially from iron ore. And then there's two major processes to convert this iron ore into iron. So, that's the first step, getting to the iron part. So, this is a very, uh, energy-intensive process. So, in the case of the mug, you would probably roll a slab to produce a steel sheet, which will then be formed into a pipe. And then the pipe would be used as the basis for the, to the interior and the exterior of the mug. You would kind of form them using the pressure of water. So, you would, put the pipe in some kind of a mould and inject water at very high pressure inside of it. So, it would take the shape of the mould and you would do that with different moulds for the inside and the outside of your mug, which will be, like, assembled later on together with the welding and then getting the vacuum and painting it a nice colour and then being able to, to use it.

Alie Ward [9:53]
And I, this is such a recipe, I cannot imagine being near a molten metal furnace and being like, let's add a little nickel. What happens if we put 0.15? You know, percent carbon? Who came up with this?

Dr Anna Ploszajski [10:10]
All of knowledge from steel comes from the knowledge of blacksmiths, you know, centuries of blacksmiths who worked with this stuff with their hands and chemists and material scientists are then built on that knowledge to, to industrialise it and to make all sorts of other things.

Marie-Pierre Paquin [10:23]
Well, the, the long story, so steel has been around for quite a while. Uh, but it was mostly made like, uh, with a small batch, very expensive, not scalable process until the 19th century where Bessemer invented this new process where it greatly reduced the cost of steelmaking at that point. And that was like the ancestor of the current blast furnace. So that was the, I would say infancy, of the industrialisation of steel making. So, they got to those recipe that fits the purpose of steel. Steel is a very versatile, uh, metal or alloy, I should say.

Dr Anna Ploszajski [11:03]
So, Alie, did you have any idea how much prior knowledge and how much artistry had gone into the stainless steel of your mug?

Alie Ward [11:12]
I knew it was magic. I mean, I knew that there was so much magic and molecules. And I think that's what I love about science communication, too, is like, some people don't think that they're science people or science minded, but just think of the thing you love the most. And there's so much background and context and science and tinkering and so many hands and minds went into having that thing in your life. I do have a question though, and this is something that I've seen in the news recently that some cups, vacuum sealed stainless steel mugs, will have a lead plug in them and people are very worried about that. How are they sealing that vacuum? Is there a plug in there like a bicycle tire? What's going on?

Andrea Sella [11:58]
When you make them out of glass, you know, you have a glass blower and what they will do is they will hook up, they will build it with a glass tube and then they'll heat it up with a torch. The whole thing's under vacuum, heat it up, melt it.

But how it's done with the, with the steel ones, I assume that there is some kind of plug, but remember it's on, it'll be on the outside. It won't be inside. Inside the mug. Right? So, one thing that has happened, you know, over the last 20 years is that as, as lead has become progressively less fashionable.

Because of, you know, lead in gasoline, petrol, whatever. And so, the amount of lead in most solders is very, very low. So, they're, they're, you know, very high in tin. And then they have a little bit of something else. I wouldn't worry unduly.

Dr Anna Ploszajski [12:48]
We can all sleep easy then.

Alie Ward [12:49]
Yeah, I still, I still accept my mug with open arms and mouth.

Dr Anna Ploszajski [12:59]
So, we've heard a lot then about the kind of complexities of the processes that go into making these materials and these objects that we love so much. Alie, I'm now going to transport you to a horrifying future world in which vacuum cups no longer exist. What would that be like for you?

Alie Ward [13:16]
Thirsty. It would be dehydrated. Because my problem is I like my water really cold. And in a regular glass cup, it gets too warm too fast. If I see ice melting and floating in a cup, I'm, uh, so yeah, I would be so thirsty. I would have to pack up from Southern California and move to an area with only glacial water. And I would just have to lap from a glacier. It's the only way I can survive. So, we better keep it together. People better not melt this world too fast.

Dr Anna Ploszajski [13:54]
On that very thing. I think I see the impact of steel being both positive and negative. So, of course, steel has allowed us to build our modern world. Okay, like roads, railways, structures like bridges and skyscrapers, cars, ships, all of these things need steel.

But the negative impact of steel is the climate side, right? The steel industry contributes 8 percent of global carbon dioxide emissions and that carbon dioxide can go on to become a greenhouse gas to warm the planet and eventually melt those glaciers. So, I want to turn back to you now, Marie-Pierre, to take us through: what do we need to do so that we will have future generations that can enjoy vacuum flasks as much as we have?

Marie-Pierre Paquin [14:33]
So, there's a lot of things we can do to seal, but fundamentally We've been using more or less a similar process over the last century to produce steel and one of the reason we've been doing that is because it's super efficient. So, the step is you take natural gas. You separate the carbon and the hydrogen and you use a CO gas and the hydrogen that is generated from that splitting of the molecule to do the reduction inside a solid, a reactor with solid iron ore.

Dr Anna Ploszajski [15:08]
Okay. So, just to compare that to the traditional processes that we've talked about, traditional blast furnaces react iron ore with solid carbon called coke, which produces molten iron and lots and lots of carbon dioxide gas, right? That's the chemical reaction. You're saying that if we use natural gas instead of solid coke as our source of carbon, the hydrogen in the natural gas can extract iron from the solid iron ore, and that process won't produce so much carbon dioxide. But the thing about natural gas is that it's a mixture of carbon monoxide and hydrogen. So, is there anything that we can do about that?

Marie-Pierre Paquin [15:43]
If we're going one step further, I'm sure you can, you can guess where I'm going, but instead of using a mixture of CO and hydrogen, why don't we use only hydrogen to do the reduction?

So, that is one way that is currently being studied very heavily and being scaled up at a different scale to prove that it's possible to be industrialised. There's some challenge with that approach. One of the challenges, the fact that the reaction between hydrogen and the iron oxide is endothermic.

So that means that it needs heat to happen, on the contrary when you were using the carbon to do the reduction where it would generate heat. So, you have to find a way to put the heat in the reactor, which is not coming from the reaction. So, you would need some other way to preheat the gas or to preheat the material before doing the reaction.

Dr Anna Ploszajski [16:40]
Right – but you could imagine a future where you get that heat from a sustainable resource, right? It wouldn't have to come from a more carbon heavy heat source.

Marie-Pierre Paquin [16:48]
Absolutely. Absolutely. There's many ways we could generate that heat. So, using renewable electricity, for example, would be one way to get that heat into the process.

Dr Anna Ploszajski [16:58]
What about just putting it all in a vacuum flask? That would mean that you could keep it, keep it hot.

Marie-Pierre Paquin [17:03]
That's an idea.

So Alie, one question, how much would you be willing to pay? Let's say you lose the mug, you lose it, you need to replace it. How much more would you be willing to pay for one that is made out of green steel versus one which is made out of regular steel?

Alie Ward [17:27]
Oh, that's a great question. I was just going to ask if they can recycle steel or not. I think the typical market value of the tumbler that I have is $22, is what the retail price is. I would pay, myself, knowing how much I use it, I would say like 100 - 150, knowing how much I use it and knowing that it was going to have that kind of longevity. I think a big part of that also depends on are you going to lose it and do you need to put an AirTag on it or insure it.

Marie-Pierre Paquin [18:01]
Okay, so I have two good news for you, Alie. So steel is one of the most recyclable product that we have. So, a lot of steel is recycled. So, that's one way to very like reduce the emission. The recycling, recycled steel is, is, is very like much less carbon intensive than like primary steel. So, if you have to recycle, like that's a very good move because it will really impact the, uh, the greenhouse gas emission.

The second good news I have for you is that you probably wouldn't have to pay a $100 for your green steel mug. The interesting thing is for a mug like yours, it's a few grams of steel that is used into the production of your mug. So, let's say we, we increase the cost of producing green steel compared to regular steel by, let's put a big number, $500 per tonne. So even if we were to increase the cost of steel by $500, that would mean a very minimal impact on your mug in terms of increased costs.

Alie Ward [19:33]
On the topic of recycling, let's say that I, my mug and I had a breakup. Let's say that, I got a mug that I no longer could stand to look at, can you just drop it off at the recycling centre? Could you put it in your recycling bin? Where does that go?

Andrea Sella [19:46]
So, I mean, one of the interesting things is that there is, uh, there's a whole underbelly to our society that we're often, I think, unaware of. And that is scrap merchants. Builders come around with old bathtubs, old boilers. All kinds of stuff. And in the UK, certainly in recent years, if you leave a bathtub out in your front garden or something, it'll suddenly vanish overnight and somebody comes by because this stuff has value and, you know, of course they can get it for free.

So, you know, actually there is, there are plentiful opportunities and what really we need to do is to make sure that it becomes. easy for people to do this, right? That, that in a sense, our, uh, recycling networks kind of become better at that.

Dr Anna Ploszajski [20:40]
Marie-Pierre, finally, if there's one thing that you think will change steel and how it's used and how it's going to appear in our lives in the future, what will be the thing that you're waiting to see that will get you really excited?

Marie-Pierre Paquin [20:53]
I think what will get me really excited is when we find a low temperature reduction process that gives us iron, good quality iron, without the use of carbon, that can deflect with renewable power at a very low capital cost. So, that's a lot to ask for, but when I get that, I'll be super happy.

Dr Anna Ploszajski [21:22]
We can dream big. Andrea, has our discussion made you look a bit differently at your beloved vacuum flasks?

Andrea Sella [21:29]
You know, it's interesting. I mean, I have, I have quite a strong emotional attachment to glass vacuum flasks. I mean, I, I, I just find your flask, they're, they're things of beauty. I use them every day. I love them. Um, I've never had quite the same emotional attachment to the, the, the steel ones.

Dr Anna Ploszajski [21:45]
Alie, how about you? What's next for you and your trusty flask?

Alie Ward [21:49]
You know, I'm definitely tracking my water these days because I'm really trying, in collaboration with my mug, to get an adequate amount of water because I think it's really funny how much people are sold moisturisers and, uh, and other things when really, oh, we're just really thirsty, so. I'm trying to make sure that my water to tea ratio, my chai tea, is nice and healthy.

Dr Anna Ploszajski [22:18]
Thank you all so much for your contributions to our discussions today. We've gone from beloved mugs to hopefully a future full of green steel so that generations to come can enjoy the delight that comes from a vacuum flask full of ice. This has been Things You Can't Live Without with me, Dr. Anna Ploszajski. You can listen to more episodes of Things You Can't Live Without wherever you get your podcasts and don't forget to follow, rate, and review us to make sure that you don't miss an episode.

–Ends–