Arthur Jones (00:04):
How are PFAS affecting your work and our world?
Per- and polyfluoroalkyl substances are a large class of long-lasting synthetic chemicals used extensively in industrial and household products. Many PFAS don't degrade really on their own, and some are highly mobile in the environment. They can be found worldwide in water, soil, air, plants, animals, and even our bloodstreams.

(00:31):
We're still uncovering the full impact of these chemicals on the health of humans and our environment, but here's what is clear. It's a complex challenge at scale to globally remediate these so-called forever chemicals. Add fast-changing regulations and different geographies and regional differences to the scale in response to this PFAS challenge, and it all compounds the difficulty.

The way forward requires a greater understanding of the risks and challenges of PFAS. But that's just the start. We'll need cross-sector collaboration and innovation to tackle the issues and apply the right measurement tools and technology.

(01:06):
Our guests for this If/When episode are helping to define these solutions for clients, communities, and the industry at large. **Sharon Minchak** is the global solutions director for remediation and regeneration at Jacobs, and **Dr. Russell Ford** is the global director for drinking water and reuse solutions at Jacobs.

(01:24):
Sharon and Russell, thank you for joining us today. Before we jump right into the detailed PFAS questions, could you both please give us some insight of how your careers have led to where they are now, where you first encountered PFAS? I'd like to start with you Sharon.

Sharon Minchak (01:41):
Well, oddly enough, my career started along with Russell's. We started working together about 30 years ago, and so, we go back a long way. And after those early days where my path led me was down the environmental remediation road, looking at a variety of contaminant classes over the years to understand how they behave in the environment, how their toxicity impacts humans and other ecological receptors and how we can remediate them.

(02:15):
PFAS arrived on the scene in, oh, the early 2010s, and it was actually on the heels of Safe Drinking Water Act regulations that initiated sampling for what at the time were called unregulated compounds. And as that sampling began to happen throughout municipal water systems in the United States, the ubiquitousness of these synthetic compounds, PFAS, became apparent to everyone and it really started to pick up speed.

And we have been looking at it ever since, but obviously the scrutiny has gotten more and more focused over the last few years, right, Russell?

Dr. Russell Ford (02:59):
Yeah. Exactly. And yes, we have been working together a long time from sitting next to each other. My career started a slightly different. I came out of school as a chemical engineer looking for work. Wound up working in consulting, started doing drinking water. Early in my career, started working on regulatory compliance and cost documents for contracts with EPA, developing regs for synthetic organic chemicals and lead and copper, and all these different things. And my career led me to drinking water treatment where I, over the last 35-plus years, have been working in designing water treatment plants.

(03:35):
As Sharon indicated, early in the 2000s, the PFAS-related compounds kind of came into play. I was sitting on a couple of state regulatory advisory boards for regulatory setting entities and also for the EPA Science Advisory Board at one point in time. And these compounds were coming up and the challenge was as they started to realize that these are potentially harmful, the health effects data and the toxicity data wasn't available.

So, the regulations kept changing and they kept putting out numbers, "And is it really harmful in drinking water? Is it harmful in the environment?" So, over the last, I'd say 14, 15 years, more information has come to light and it's made it very important, in my case, the drinking water side of how do we remove them from drinking water to protect public health?

Arthur Jones (04:26):
It's fantastic to hear about your collaboration and how long you've worked together. It's amazing to hear that and the changes to the industry and how both of you have adapted in terms of careers. But I'm going to take a step back. Could you, I mean, explain exactly what

PFAS are and where these chemicals are found? And Russell, could I maybe start with you on this one?

Dr. Russell Ford (04:46):
Sure. And I'll make sure I say them correctly, but they're per- and polyfluoroalkyl substances, also known as PFAS. There's a host of compounds within that general category. You hear people refer to a couple that are in the regulatory environment, but there's over 50-plus compounds in the environment.

(05:05):
The compounds were developed over 50 years ago for a lot of different things, firefighting foam, flame retardant chemicals, waterproofing. So, it's in everything we do in the environment. Relatively ubiquitous in the environment. And actually, a lot of the research has shown that at some point everybody has some of these compounds within their bloodstream because they're everywhere. And the challenge with these compounds are that they're designed to do exactly that. So, they're in the environment here and it's a challenge.

Sharon Minchak (05:44):
Yeah. And I think a thing that's interesting about PFAS that is a little different than other contaminants that we've dealt with in this industry is that as a society, we have really invited these into every nook and cranny of our life. They're in the waterproof clothing we use. They're in the Teflon pans that people made their scrambled eggs in for years. As Russell said, they're very ubiquitous and they are very good at doing exactly what they're supposed to do, which is what makes them a challenge to address, to treat and to remediate.

Arthur Jones (06:24):
Well, that's fascinating. I mean, firstly, the ubiquitous, I didn't realize they are so widespread. And secondly, the fact that they've been designed so well actually causes the problem that we are facing right now. But that actually leads beautifully into the next point. What are the biggest misconceptions or myths that surround PFAS? And Russell, if I can start with you again on this one?

Dr. Russell Ford (06:44):
So, that's great. So, they're called forever chemicals, and we won't get into the technical science of why they're called forever chemicals and the bonds that keep them together, which makes them so challenging to mediate.

(06:57):
So, one of the myths are that they're there forever, but one of the things we have is we can remove them from the water, or the air, or the soil. There are technologies available to remove them. The challenge is that we remove them from one medium to the other, because they're very challenging to destroy at the moment. So, they can be removed, but they're very ... So, a lot of work is being done to look at how to destroy them in the environment, but right now we remove them from one medium ...

So, I take it out of drinking water, I put it on some kind of material, it gets out of drinking water, and then you have to either incinerate it or dispose of it or landfill it to that effect. But the myth is that they're there forever, but they can be removed.

Sharon Minchak (07:41):
Yeah. And I would add that whether it's a myth or a misconception or it's just a lack of what people understand and we even as an industry understand, is that there's definitely a lot of stir on this. There's a lot of discussion. The press, social media seem to have taken the knack of sensationalizing it with this fear factor versus necessarily worrying about understanding the real issue.

(08:10):
But the reality is that we really are only starting to truly understand what the toxicity of these substances are and how they behave in the environment, how they behave in us as humans and in other ecological receptors. And so, while it might seem obvious to say, "Well, if we're not sure how they impact us, then we should say, 'We don't want any of that.'" But that ship has kind of already sailed.

They are in our lives, they're in our environment, they are in us.

(08:47):
So, the focus, I think, in going forward really needs to be how do we put our very best science forward? How do we accelerate that understanding? How do we look at ways to truly assess what toxicity means to us and to other receptors? And we really figure out how we

need to concentrate and focus on the areas that we need to prioritize to create the most benefit for us, for the environment, for the future.

And we also probably really need to take a long, hard look at how many of our consumer products actually still contain these materials when we are talking about concentrations that we find unacceptable in the environment, but we still actually really like the properties that many of these items have. So, it's kind of rectifying that in our minds.

Dr. Russell Ford (09:46):
Sharon, can I just jump in on that again? I think with the health effects around the world, it's not consistent either. So, one of the challenges is that every region of the world is looking at these compounds at a different health effects, toxicity, how it impacts the environment. So, you get different interpretations of what the data says at the moment. And there's not consistent interpretation of the levels.

(10:13):
And I think to put it in perspective, and I try to avoid being technical, but that's just what I do, is we're talking in drinking water, looking at regulating this potentially, in the US, down to four nanograms part per trillion. So, four pieces of this puzzle into a trillion gallons of water is what we're looking at. And the health effects data is showing similar issues in different media, whether it's soil or air and contact. And Sharon said it's ubiquitous. So, it's in our system because we've had flame retardant chemicals, we've cooked on Teflon pans, we've worn flame retardant ... We've drank water that has it. So, that's the challenge right now is getting some consistency on the interpretation of the health effects and toxicity and how we want to actually regulate it. Is it a multimedia approach in terms of getting out of different medium or is it one medium approach? That's one of the challenges.

Arthur Jones (11:18):
Thanks, Russell. And I think you brought up a very pertinent point around consistency because the next question is about the fact that remediation for PFAS differs in the water and environment sectors in terms of the society focus and the specific challenges. And I know that both of you have spoken about your different careers and the different focus on these sectors before this. But what would you say are the biggest obstacles facing the industry globally? And how is Jacobs creating a solution to address these issues?

Sharon Minchak (11:48):
I'll take a stab at that. I think from the environmental market perspective lens, one of the things we've talked about that they're ubiquitous, these are ubiquitous in our environment, but as we look at individual sites that have been impacted, it's really important that we understand what we really are looking at, that we really are understanding the source areas and that we're able to evaluate how we need to truly address that. Of course, we want to go out and remediate a site, but if we're just remediating a downgradient issue that we see and we don't understand where it's coming from, how it's moving in the environment, how it's moving in the groundwater, how it's still present in the soil, we're signing Russell up to treating that symptom for forever, because we're not actually getting to the root of the issue.

(12:50):
And so, that is a challenge for us and understanding how we really need to figure out the way these behave and then identify the best strategies for addressing them. If we take a cue from our history and the environment market and we think about a compound class that's driven a huge amount of the remediation and cleanup work we've done for the last many decades, chlorinated solvents, things like trichloroethane, back in the day we called them recalcitrant because at that point, we didn't know how to address them. They were hard to remediate, they were very persistent.

(13:38):
But today, through understanding the science, through looking at different approaches and really filling a toolbox with a lot of good ways to address them, we've been able to identify really effective sustainable ways to address chlorinated solvents and to do it right in situ, in the ground, in the groundwater where it is.

I mean, make no mistake, it's taken a long time, but we do have very solid strategies to address those issues, which were the big issue 30 and 40 years ago. So, we'll get there with PFAS as well, but we really need to focus on the science and put a lot of good tools in the toolbox. And it's, I think, really important to also understand that there isn't just one cure-all out there. This isn't going to be one magic bullet that is a quick fix.

Dr. Russell Ford (14:39):
And I'll add in, it's like on the drinking water space or the water space ... I'll just focus on the

water space because there's actually two avenues for that too. I'm going to go in reverse order. So, on the water space, on the wastewater, right? When you have a wastewater treatment plant that removes stuff from the water and it has to discharge into the environment, these compounds get concentrated into biosolids. And then usually the sludge or the residuals, they get land applied. So, then you're worrying about getting these compounds out and then land applying them.

So, there's a host of regulations that are going to be coming forth looking at what's the impact of that in the environment, because you've got a concentrated solid in the system?

(15:21):
On the drinking water side, we don't talk about remediation so much, but as Sharon mentioned, if you can find the point source, if you could find out where it's been discharged to the ground because somebody physically contaminated the site, then yes, if you can remove it at the source, it's much better. Eventually the groundwater will be cleaned up and the treatment plants will not have to deal with that.

(15:43):
But unfortunately, since it's so ubiquitous in the environment with stream runoff and rainfall, and it's coming into our waters and streams and our groundwater systems, our wells, and then our surface water, rivers and reservoirs. And so, now we're being forced because in some markets, and like I mentioned before, the level of inconsistency in the regulatory environment. In the United States, they're looking at potentially four nanograms per liter, four parts per trillion. But in say, Europe, in the UK, they may be looking at 10 to 100 nanograms. It's a substantial difference. And the difference between treating down to the US level of four requires a different, more intense level of treatment and brings more water facilities into play than maybe treating down to 15, or 20, or 30. Right?

(16:37):
So, the treatment is easy from our standpoint. We can remove it using various technologies that are established right now. Remove it from one medium to the other. But the challenge is getting ... There's a cost involved with that. There's a huge capital expenditure to get down from ... And I'll just use an example for the US market. There was a health advisory of 70 parts per trillion. Right? Now the regulation's four. Difference between 70 parts to four, how many water facilities are impacted? It went from not many being impacted to almost every water utility that's on a river or stream, having to look at their water and being impacted based on the regulatory data that's out there.

Arthur Jones (17:28):
I mean, what are regulators doing right now globally? And is PFAS getting the scrutiny it needs? But it sounds like the regulation is a challenge because it keeps changing and it has to keep changing to obviously update and to follow and align with, obviously, the science that's coming out and what we are learning. But I'll go back to the question, do you think it's getting the scrutiny it needs?

Dr. Russell Ford (17:49):
I believe so. I believe so. I think they're looking at it. I think it's been brought to the attention that we need to look at it and get consistency in the health effects data. I think when we talked about how long we've been dealing with this reg. And back in the early 2000s, I remember sitting in conversations with various toxicologists, having differences of opinions of the level of PFAS and the health effects and what the risk should be. And so, I think the industry as a whole is coming together more on the toxicology data, the health effects data, looking at which medium you want to look at and remediating it in.

Like you said, do you want to go after the soil, the air, the drinking water, or all of the above? And how do you do it? So, I think these have been brought to the attention.

(18:30):
I think the more critical part, and I'll let Sharon jump in this more on her side, is it's obviously how do we remove it from the environment over time? So, the manufacturers have to start looking at, "This is the stuff that's in suntan oils and things of that sort. How do I remove this from the product we're using and keep the product viable for the user, and still have the same intended use, but remove these compounds from it?" So, the manufacturers look at that, then it gets into the environment, then it gets into the drinking water and the wastewater, and so on. So, that's the challenge from a regulatory standpoint is where does the regulation actually start and stop?

Sharon Minchak (19:15):
Yeah. I would add that, I mean, as Russell's hit on, there's a lot of focus, there's a lot of attention. And that kind of varies widely across the globe, across even within the US. I mean, we have federal standards for drinking water that are promulgated now, but it doesn't

translate directly to what our cleanup standard's going to be. And there are states that are doing things that still are different. And how do we bring all of these stakeholders, regulators, manufacturers, our industries, the public, together, collaboratively to say, "How do we really want to manage this global issue? How do we want to think about the way we direct and invest resources to address this important need for us?"

(20:08):
But when you look at the idea of trying to remove every molecule of PFAS in the world, you're going to probably drive climate change issues because that's the magnitude that we're looking at. And a big issue we all have to come to grips with is what is in the background? What do we set as a background level?

Not saying that we just accept that and not pay any attention, but are we driving investment of resources to try to achieve cleanup level that when you have a background condition that you really can't control in the same area? And how do we really rectify that? How do we understand, again, what is really the toxicity for us and how are those exposures occurring?

(21:05):
As Russell said, that product lifecycle, that sort of product stewardship upstream, where can PFAS be replaced in manufacturing processes, where can they be replaced in products so that we're simply eliminating that from the input source, from the equation? There are places it can be eliminated, as we've talked about. These are highly utilized, useful industrial chemicals that for some industries there aren't adequate, appropriate replacements at this point.

(21:44):
But in manufacturing processes for years, we use toxic materials and we just are aware of how they need to be managed, how they need to be controlled, how they need to be minimized, how we need to look at wastewater management, how we need to look at recirculation and recycling within industrial processes. So, bringing that lens to really addressing the whole lifecycle.

How are we using these compounds? Where are they? How do we manage them? If they do enter the environment or they have entered the environment, how do we appropriately address them?

(22:18):
And then, if we're really looking at the receptor protection in the drinking water space, then

we're taking care of that as actually sort of the final link in the chain. We would prefer to not have to be treating these in groundwater. We'd prefer they not be there, but they are, and they are treatable.

That's the good thing. But there's definitely a lot of focus, there's a lot of energy, there's a lot of regulatory emphasis. And getting all of those input signals to line up, and that might be wishful thinking, but it would be helpful to the industry as a whole to be able to make the best informed decisions about prioritizing resources.

Arthur Jones (23:04):
I mean, that's very insightful, and once again, it raises the complexity of the PFAS challenge. What would be the biggest opportunities, in your opinion, to address the PFAS challenge? I'll start with you, Russell, on this one.

Dr. Russell Ford (23:17):
Yeah. As I was thinking about, listening to Sharon, the opportunities for us are innovation. That's what we do best, we innovate. We change the way things are done. So, I mentioned in the manufacturing process, in the environment for us on the drinking water space, in the water treatment space, we remove these compounds from one medium to the other, but we still have them to get rid of whether disposal.

(23:44):
So, I think looking at destructive technologies, as I mentioned, I'm not going to get into the detailed chemistry of these compounds, but the bonds they make are very challenging to destroy. So, Sharon mentions climate impact, sustainability. It takes a lot of energy to break those bonds. So, now we're looking at solutions that might incorporate alternative energy sources to help alleviate the ability to destroy these compounds.

But I think there's going to be innovation here. There's efficiency. And you look at what's been done over the last 50 years and just general technology, I think we have an opportunity to innovate in this field, to work to look at destructive technologies to destroy these compounds. And then, when you can do that ... But you need to do it efficiently and you need to do it sustainably, because other than that, the current method for us removing them in the drinking water

space and even in the wastewater space, is not sustainable by using material and just replacing it from one to the other, and then, trying to destroy it or landfill it. It's not sustainable.

Sharon Minchak (24:43):
And I would say that one of the biggest opportunities, but it's also one of the most daunting challenges here, as I was saying before, how do we really work across all of those stakeholders, all of our industry colleagues, all of the public and the regulators, to be able to look at this big picture? I feel like a lot of people know one little piece of the picture, they see one lens into it, but understanding that there is a big picture and that we need to understand that whole thing to identify the most important pieces of the puzzle to start with and do the most good we can as quickly as we can.

(25:25):
And at Jacobs, it's really exciting to be able to tackle this holistically across all the different domains of expertise we have. For Russell, as drinking water engineer, he wants to innovate and create sustainable solutions that let us help deliver safe water to our communities. As an environmental remediation specialist, I want to understand how these substances move in our water, in our soil, and how we can remediate them before they're a problem Russell has to clean up.

(26:01):
And we have teams of industrial water process engineers, advanced manufacturing engineering teams here at Jacobs that can really help our clients look at those industrial processes and those materials and find new ways to manufacture the things that we need in our world if we don't want to use PFAS in the procedures anymore. We still have things that have to be done. So, it's a really big challenge, but it's a really big opportunity for us to help improve the world. And as an industry, we have tackled challenges like this.

And with an amazingly diverse company like Jacobs, we really have a lot of brain power and thought leadership to bring to the issue with a lot of enthusiasm, with a lot of passion, a lot of commitment. And I think we got this. It's going to take a while, but we're up to the challenge.

Arthur Jones (27:00):
Sharon and Russell, thank you so much for providing all your insight into this complex global

PFAS challenge. Our main lessons from this discussion start with a newfound appreciation of just how complicated PFAS treatment and remediation can be and how important it is to correctly identify and address the contamination at the source and focus carefully on the exposure pathways.

(27:21):
It's also insightful to hear how mitigating the risks and liabilities of PFAS for communities and clients relies on tailored approaches built on innovation and collaboration. You've both provided the answer to the PFAS challenge, which is multi-stakeholder partnerships supported by the best talents and technology, just like the way the two of you work together. So, thank you very much for this excellent discussion.