

## CERAMIC TECH CHAT

Episode 33

Title – “Actions for a sustainable future: Jürgen Rödel (E33)”

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### INTRO

De Guire: “I’m Eileen De Guire, and this is Ceramic Tech Chat.

In the past few years, numerous and ongoing extreme weather events around the world have shined a spotlight on what could soon become the normal pattern because of climate change. In response, ‘sustainability’ has become a buzzword in government and industrial circles when deciding on new policies and technologies to adopt to address these changes.

But while this term ‘sustainability’ is often used, just what does it mean?”

Rödel: “If there is sustainable life, it means that people living in 10 or 20 years have the same conditions on Earth as we now have. This will happen if you only use resources on Earth which the Earth receives from the outside. Means from the sun, and therefore from the wind, and therefore from the tide. And we do not pollute the Earth.

At the moment, we use 1.8 Earths instead of one all over the world. So, we are what is called in overshoot. And this depends very much from country to country.”

De Guire: “That’s Jürgen Rödel, professor and ceramics group leader at the Technical University of Darmstadt in Germany. In recent years, he has become actively involved in learning about and discussing with others the dangers of climate change and what we must do as a society to live on Earth more sustainably.

What are the most concerning effects of climate change, some of which we’re already starting to see? And what actions can governments, companies, and individuals take to preserve the Earth for future generations?”

(music)

### SECTION 1

De Guire: “So, climate change is a topic we’ve heard about for decades. But the discussions reached new levels of urgency last year when the United Nations Intergovernmental Panel on Climate Change released its sixth assessment report since 1988 on the issue of climate change. And for the first time, the IPCC unequivocally stated that human activities have had the greatest effect on warming the world, far more so than natural climate change drivers.

Your main body of work has been in developing lead-free piezoelectric ceramic materials. So, would it be fair to say that your career has been motivated for a very long time by a desire to discover materials that function well but without creating a negative impact on the environment?”

Rödel: “I’m afraid it was not so clean as one may think now. When I was an undergraduate student, I read ‘Silent Spring’ by Rachel Carson, I read ‘The Limits of Growth’ by the Club of Rome, and other books. But when I moved to the U.S. to do my Ph.D., and then I got a full professorship five years after graduation, I was under considerable stress. I was in a new department, and I was head of teaching and had to develop the whole program. At that time, the Cold War had ended. It seemed like there’s no worries on world anymore, so I got complacent. Only in 2005 I started to work on sustainable materials, and only in this year [2022] I started to reach out to the general public.”

De Guire: “Okay. As you study this issue of sustainability, what areas of the world are or will be most affected by sustainability gaps?”

Rödel: “Actually, there is a long list. Regions where farming is now already difficult—parts of Africa, South America—will not provide food for their citizens anymore. Fishing grounds are now already getting depleted. The heat will be stifling each year. In Bangladesh and in India, this summer the temperature reached 45 degrees C for many days in a row.

When we hear, ‘Okay, it gets one or two degrees warmer,’ we think it’s not that much. But the human body is a thermal engine of about 100 watts. It heats up all the time. If the environment is too hot and too humid, the human body cannot cool itself anymore because it cools itself by sweating. But when the temperature’s too high, there’s too much humidity in the air, you cannot cool down by sweating; you will just keep heating up.

And next is farming. There will be regions where more and more flooding will occur. Bangladesh, low-lying islands, also the Netherlands, New York, and other coastal towns.

Then there are regions which are susceptible to hurricanes. For example, in the east coast of the United States, [hurricanes are termed] typhoons in Japan. But there are also new regions. For example, Germany had an average 200 typhoons per year in the last decade but had 20 per year about 20 years ago. So, even in these areas, it’s getting considerably worse.

As a result—and, I mean, this is kind of understandable—people from the affected areas will start to migrate to other regions. I mean, if they cannot find food anymore, there will be pressure in Africa to move north. And there will be pressure from Central America to move toward the poles.

So that’s my list for now.”

De Guire: “Definitely as you describe it, a truly global situation.”

Rödel: “Yes.”

De Guire: “No area of the world is unaffected. No economy of the world is unaffected.”

Rödel: “Yes.”

(music)

## SECTION 2

De Guire: “So, that means that we need some governmental solutions, some corporate-level solutions, and some individual-level solutions. So, let’s talk a little bit about what your thoughts are about each of those levels. So, what do you see as the role that governments can take, and are there different approaches that might be involved based on what situations are?”

Rödel: “Yes, I think so. I think governments should formulate legal boundary conditions. For example, the damage to the environment during the production process should be priced into the manufacturing. In Germany, the national government had guaranteed, for example, a price for solar energy, and then the companies could have additional business by developing it. Therefore, the renewable energy in Germany increased a lot in the last 20 years.

Clearly if governments act now, it will cost more money. So therefore, not everyone will agree. In the long term, of course, the money we invest now will be much less than the money we will need later to mitigate the damage by storms and floods.

There was last year a small river by the name of Ahr, in the Ahr valley. Most Germans have never heard of it. And it’s usually one meter deep. It suddenly flooded. No one knows how high the river went, but there was a measurement device which broke off at six meters high. The damage supposedly is \$30 billion. That was a small river, and it just destroyed everything in the whole valley.

So, if you now look at different countries and different government policies, kind of unified people and unified government will have less problems to act for long term. I think you see this, for example, in Finland, New Zealand, and some of the northern countries because they actually have priced production into it already. I think in New Zealand, nature is already a legal person and could go to court. So these things, extreme as it may sound now, may come more.

Governments with polarized people, of course, will have more problems to act. And it sounds strange, autocratic countries like China, where there’s just one person deciding everything, of course they will act faster. The question is if they will act right, but they will definitely be able to act faster.”

De Guire: “Okay. So, most major corporations do have sustainability initiatives. So, the question is, are they doing enough and are they doing the right things?”

So, just as an example, Kyocera, a major ceramics manufacturer, has plans to be carbon neutral by 2051, and by 2031, they plan to adopt 20 times the renewable energy sources than they used just as recently as 2014. In Germany, the Schott Glass Company has announced plans to be climate neutral by 2030 through electrification and the use of hydrogen technology.

Are these types of efforts on the right track? And are they enough?”

Rödel: “I must say I’m awfully impressed what long-term visions companies have. There are also big American pension funds who invest into green alternative businesses. And there are other companies. Particularly Japan seems to be very concerned, and many Japanese companies are. In one of my sabbaticals, I was in Japan, and that always came up when I visited companies. I have met the CEO of Schott because 15 years ago he was the president of the German Materials Society. I am very impressed by this guy, and so I’m sure they are trying to be on the right track.

But you must be aware, if you read—and this is now other companies—if you read what they say about their efforts, that’s often what we would call ‘green washing.’ That is, they try to be very attractive, and they make some statements, but in the end, if you look at it, it will have very little effect. So, you need to scrutinize some of this. But again, many companies, although they should be kind of short-term oriented shareholder companies, with their shareholder reports, they really look truthfully into the future.”

De Guire: “So, that makes me wonder, the ceramic and glass industry is basically a high-energy user. Most of the processes are high-temperature forming processes. We fire things, we melt things, we heat treat things. Does that mean that our industry maybe has an opportunity to be a leader and show the way to other companies, how to really be sustainable?”

Rödel: “Oh definitely. In Germany—I’m sorry, that’s all I know—the number one industry in energy use is chemical industry. Number two is metallurgy and steel industry. Number three is glass and ceramics. So, we need a lot of energy, and as it happens, particularly in the last 10, 20 years, there’s more and more research at least into different sintering technologies.

As an example, one of my Ph.D. students has several patents submitted on what he termed blacklight sintering. So, he doesn’t heat up with thermal energy by putting everything into the furnace. But he uses high-energy light, so high energy that it’s black, that is, below the visible or near ultraviolet. That’s light [providing energy] higher than the band gap. And then it heats up a piece of ceramic in five seconds, and you don’t need a container, you don’t need a furnace, you don’t need an electrical contact. The energy you use is about 40% that required by other heating energies. But of course, it’s not so straightforward because you cannot just take a big piece and shine the light on it. For flat pieces, it will

work for now. But he's in contact with several companies, and he got money from our new government agency on disruptive innovations.

So, I think there are certainly options because if you use a furnace, depending on how many pieces you make, there are probably more energy-efficient processes one could think of."

De Guire: "And of course there's some, in the last five years or so, there's been a lot of research into a cold sintering process. Clive Randall at Penn State has really kind of been the leader in that area, but others are starting to, really trying to understand cold sintering. And it depends on a different type of transport process. That could also be a disruptive technology."

Rödel: "Exactly. As I said, this is good. There are several processes coming up. There is cold sintering, which I think was clearly one of the leaders. There's sintering by electrical current, and like with cold sintering, you don't need to go to the same high temperatures, which is, of course, a big advantage because that drives the energy use. So, all of these, they need to be developed, they need to be compared, and they may have their place depending on geometry of product you are envisioning here."

De Guire: "Right. And with cold sintering, it's also under high pressure—at least right now, they utilize pressure—so there's, you have to get the energy from somewhere, so I guess you have to look at then, what is the cost of getting the high pressure. Are you using unsustainable energy to get the high pressure. So, there's a lot of engineering but some really exciting technologies coming forward."

Rödel: "I think so."

De Guire: "So, as we think about manufacturing and businesses, is there any kind of inherent conflict between business and sustainability? So, for example, if I make my smartphone last 10 years, or I only buy used cars, how does a company make money over the long run?"

Rödel: "That's true. It looks first like there is an obvious conflict. First, to go back a little bit, what we are looking for is we want to stop growth of ecological footprint. It does not necessarily mean we need to stop economic growth. We just need to decouple it. If we have an economy which is more based on circular economy, then we can produce goods that do not need too much energy and too much resource.

Also, what we are looking for is a transition into new types of economy, which may be, to a certain degree, regulated by government or there may be incentives. So, there are many new opportunities for businesses. We need environmentally friendly energy, we need environmentally friendly transport, we need more friendly housing, and so on.

So, you see, I'm old enough to tell you that in my youth, there were no smartphones. And smartphones, they're not quite 20 years ago. So, if we now think, 'Of course I need to buy a smartphone every year,' we may not think so in 20 years time from now."

De Guire: "Yeah, so, you're thinking that companies need to think a little broader than the products that they make and think about how they can create products that have a sustainability to them. And when we think about the circular economy, I think that it also includes the end of life of a product. You know, how do we take it apart and reuse the parts that can be recycled or reconfigured. Do I understand that correctly?"

Rödel: "Right. Also, it may be much more sustainable if we buy not so many goods, but we lease goods. So, if we lease cars, if we lease smartphones, and so on, then the companies would be in charge of recycling them, and then they would make a business out of it."

(music)

BREAK

De Guire: "Achieving sustainability goals requires working with a diverse community of stakeholders. ACerS' 'Fostering equity in science' webpage provides the materials science community a readily accessible list of recommendations for fostering inclusivity and equity when working with diverse groups. Visit the webpage at [www.ceramics.org/fosteringequity](http://www.ceramics.org/fosteringequity)."

SECTION 3

De Guire: "What about individuals? You and I wake up every day and live a life. What can we as individuals do to advance the goals of sustainability?"

Rödel: "I think it is not enough if we just have our own personal goals because not many of us have the chance and the time to read the books and to have the discussions. So, we need to extend our range, our contacts. We need to involve societies, like The American Ceramic Society. We need to involve the businesses we are working with. We need to involve and discuss with the universities we are working with. We need to discuss with the members in our soccer club, and so on. I mean, it cannot be that we are facing such a big problem, and nothing happens. It must be that the knowledge is not sufficiently clear.

I think, for example, the engineers, we have chosen this profession because we are thinking we have a certain intellectual ambition, which goes further than our own self. We want to do something for the society around us. So, we then should reach out with this topic also around us and should involve other stakeholders."

De Guire: "So, what kind of future plans do you have to continue this conversation? Now that you've started to reach out to our community and your home community, what would you like to see come out of the conversations that you're having?"

Rödel: “I will try to involve more societies. Of course, I’m not sure if all will be so receptive as The American Ceramic Society to what I’m trying to discuss. I will give more talks. I have a 40- to 50-slide PowerPoint talk, which is called ‘From 1450 to 2050,’ and it tells the narrative of when sustainability started and how ecological footprint went up, and what were the critical years and what were the critical decisions at what time. And I have a group of people who helps me.

Then I will try to work with German universities. I mean, of course I need to start with my president and with my group to make statements and formulate boundary conditions. I managed to get her that our next big meeting in February will have this as a topic, but the university will decide.

I found out at Swiss universities have all rules about reducing the flight miles. I was told that Swiss universities and their researchers are not allowed to fly if they can take a train in nine hours. I mean, that’s substantial. I have stopped flying around in Germany five or six years ago, but...well, actually, there’s one place I need nine-hour train ride. But that’s about the scope.

So, this is what I’m trying to do. It may sound very futile because I’m not, except for my scientific societies, I’m not part of any particular organization. But I think everyone needs to try to do what he can do.”

De Guire: “Well, that’s great. I think it’s really important for people who have the stature in the field to use that voice and to look at a bigger picture and to create that call to action.”

(music)

## CONCLUSION

De Guire: “Climate change is a global issue. Fortunately, when individuals come together as communities, we can work together to implement policies and initiatives that advance us toward a sustainable future.

I’m Eileen De Guire, and this is Ceramic Tech Chat.”

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“Visit our website at [ceramics.org](http://ceramics.org) for this episode’s show notes and to learn more about Jürgen Rödel and sustainability. Ceramic Tech Chat is produced by Lisa McDonald and copyrighted by The American Ceramic Society.

Until next time, I’m Eileen De Guire, and thank you for joining us.”