INTERVIEW: PHILIPPE DETHIER

Particle Accelerators Have Advantages for Irradiation

IBA

Philippe Dethier: "E-beam and X-ray sources are powered with electricity, so if you switch off the machine, you have no more radioactivity going around."

Philippe Dethier is the marketing manager of IBA, a Belgium-based international company that supplies ion beam accelerators and associated technologies. He was interviewed by Ilko Dimov.

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21st Century: **Can you tell us what your company does?**

Dethier: IBA supplies particle accelerators for multiple applications including medical device sterilization, polymer crosslinking, and food irradiation.

When it come to food treatment, irradiation technologies are clean alternatives to traditional fumigant technologies such as ethylene dibromide (EDB), methyl bromide, ethylene dichloride, and hydrogen phosphide, which are pesticides banned in many countries for health and environmental reasons.

There are three main irradiation technologies for food: electron beam, X-ray, and gamma ray (or cobalt-60). IBA is active in irradiation technologies based on e-beam or X-ray accelerators, using electricity as the source power. Whether you choose one or the other technology depends on the products you are processing.

E-beam is very efficient but has low penetration properties, and is suited for bulk processing of small-dimension products. The main difference between X-ray and e-beam is that X-ray has high-penetration. Such high penetration properties allow treating products on pallets, which is typically what the food industry requires.

Here at IMRP 2011, we are introducing a new technology, high powered X-rays, able to treat food on pallets, with a technology that is fully powered with electricity.

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IBA's Rhodotron TT1000, which is now operating in a Swiss medical device sterilization plant, has multiple beamlines which allow the energy to be tailored to the product, using X-rays or e-beams.

21st Century: **So the source of the X-rays is not radioactive?**

Dethier: Exactly. E-beam and X-ray generators are powered with electricity, so if you switch off the machine, you have no more irradiation generated. And that's why we believe it is the future, not only from a safety point of view, but also from an economic point of view. If, for example, a food producer wants to treat food only during peak season (let's say three or four months of the year), you can completely switch off the machine during the off-peak season and stop your costs related to electricity.

With irradiation technologies based on radioactive sources, such as gamma irradiation, if you close the facility for three months, your gamma source is still decaying (losing activity), which represents a cost without any product being treated.

21st Century: **So this is good, because it resolves many ques-**

tions regarding proliferation, terrorism, and all this crazy stuff.

Dethier: Exactly. X-ray systems do not require radioactive sources. Electricity is available all over the world. . . .

21st Century: **Right now there is a food poisoning epidemic in Europe, in particular in Germany, where many people have died from *E coli*. How can your machine treat this problem?**

Dethier: Irradiation technologies can indeed help in sanitizing food.

Food irradiation is all about managing the dose you administer to your product. Product irradiation is never perfectly homogenous because of the non-homogenous density of the product and the varying distances from the product to the irradiation source. The key parameters to consider are minimum dose and maximum dose. Inactivating a specific pathogen will require a given minimum irradiation dose, which depends on the resistance of the target pathogen to irradiation.

On the other hand, authorities regulate the maximum dose which can be administered. Too high dose may also deteriorate products which have low resistance to irradiation.

So the whole game is to find a good balance between the minimum dose to kill the pathogen, and the maximum dose which is allowed by authorities and which will not damage the product.

For example, let's say to inactivate a specific pathogen I need 400 gray,[1] and authorities allow irradiation with a max dose of 800 gray. You now have your maximum and minimum dose and can decide which technology you want to use to treat your product.

The big advantage X-rays offer is to reduce the min/max dose to the minimum, compared with other irradiation technologies.

Other irradiation technologies, such as gamma irradiation, cannot go as low in the min/max ratio—meaning that for a given minimum dose (dictated by the pathogen resistance to irradiation), the maximum dose in the product will be much lower when using X-rays than when using other irradiation technologies.

Biological and Agricultural Engineering, Texas A&M

An electron microscope image of green-leaf lettuce, where rod-shaped E. coli *bacteria nestle inside a minute pore in the leaf called a stoma. Food irradiation technology can reach pathogens such as* E. coli *in stomas, but conventional technologies cannot.*

21st Century: **Is your machine already in operation?**

Dethier: Many X-ray systems are in production around the world, but we have installed the first high-power X-ray generator recently in Switzerland. That system is now in operation, and its configuration is optimized for medical device sterilization—but the technology is the same as for food treatment.

The technology is available and mature, since it is based on well-proven accelerators; but we expect the industry to require some time before being convinced by its efficiency.

21st Century: **Can you say something more about the economic effects?**

Dethier: I think it would more interesting to ask what is the expected cost per ton of treated product? Expense will become less of a barrier as irradiating food will become cheaper than the 70 euros ($101) to 120 euros ($172) per metric ton it costs now.

Costs depends of course on the volume the X-ray treatment facility handles. The bigger the facility, the more economies of scales and the better prices can be achieved.

21st Century: **One of the problems we have right now, for example in Africa, is that up to 50 percent of the food they produce gets destroyed by birds, bugs, and disease. What would an irradiation plant cost for a developing nation?**

Dethier: There are multiple applications with food irradiation which can help developing countries. Some of them are:

- Inhibition of sprouting in potato, onion, or garlic.
- Phytosanitary treatment for insect disinfection on exported products, such as grains, papayas, mangoes, avocados, etc.
- Delaying of maturation
- Control of foodborne pathogens for beef, eggs, flounder, crab-meat, oysters, etc.
- Shelf-life extension for chicken and pork, low fat fish, strawberries, carrots, mushrooms, papayas, etc.

21st Century: **Are there any government agencies in European nations that are studying the applications of your technology and that could potentially be able to put it in operation?**

Dethier: We are talking to several companies evaluating the possibility to open new X-ray facilities for food processing. For the moment, the main interest is for phytosanitary applications, where food exporters (mainly to the United States) are looking for alternatives to comply with the U.S. import regulations.

Additionally, traditional fumigation methods based on methyl bromide are banned by the Montreal Protocol.

Phytosanitary treatment requires typically a minimum dose lower than 400 gray (depending on the insect) and max doses less than 1,000 gray. The main economic advantage of X-ray phytosanitary treatment is that it opens the door to food producers for exporting local production to the U.S. market.

* One gray is the absorption of one joule of energy, in the form of ionizing radiation, divided by one kilogram of matter.