



In March 2022, potato processor Ecofrost in Péruwelz (BE) announced the purchase of two Pulsemaster Pulsed Electric Field (PEF) systems. What makes PEF machines, which treat potato tubers with a pulsed electric field, interesting to French fry, chips and potato specialties processors?

Mark de Boevere, Managing director of Pulsemaster, which specializes in PEF applications, says PEF is a game-changing technology for the potato processing industry. "It is not a machine that is just a little bit different or better than the previous technology, but it really changes things. In the world of sssFrench fries, for example, that could mean traditional preheaters out, PEF system in," he says.

Minuscule holes

What exactly happens in the potato when you apply a pulsed electric field? The goal of PEF treatment is cell disintegration. "The pulsed electric field creates holes in the membranes of the potato cells. These are very small holes with a diameter of 50-100 nanometers (a nanometer is one millionth of a millimeter). On the inside of the cell wall is a membrane that holds the contents together. Drilling holes in the membranes makes it easier for moisture to escape and evaporate, among other things, and has all kinds of benefits for the potato industry in terms of product and process," De Boevere explains. "For example, suddenly you need 40 percent less cutting force to make French fries. You cut much better, you have a nicer cut, the fries don't break as easily, they are smoother, they absorb less oil so you need less oil, you can shorten the blanching and frying time ..." he enumerates.

According to De Boevere, these effects also apply to chips production: "They're easier to cut, have smoother surfaces, and therefore 10% less oil absorption." Tough, hard produce like sweet potato, turnip and beet root become easily processable with PEF, to make French fries and veggie chips. More complicated cuts, such as deep ridge, waffle or lattice are now easier to slice with higher overall yield.

HOW PULSEMASTER PEF TECHNOLOGY MAKES BETTER FRENCH FRIES AND CHIPS

In March 2022, Pulsemaster, the #1 provider of pulsed electric field (PEF) systems for the potato processing industry, has entered into an agreement for the sale of two PEF systems to Ecofrost. Belgium-based Ecofrost specializes in an extremely diverse range of French fries and potato products tailored to each customer's needs. "Ecofrost is a well-known Belgian company in the world of French fries. They are known for introducing innovations in the production of French fries, and other companies are taking a close look," says Mark de Boevere. "We are very pleased that Ecofrost, a Belgian customer with very high standards and a worldwide reputation, has awarded us the contract for its first and second Pulsemaster PEF systems at the Péruwelz plant in Wallonia."

Electrical field strength and specific energy

Potato treatment with PEF, to treat whole potato tubers at a capacity of up to 60 tonnes per hour to make French fries, involves two main parameters. "You can treat potatoes peeled or unpeeled. However, to connect the electric field with the potato, treatment in water is required. You have two parameters: the electric field strength in kilovolts per centimeter and the specific energy in kilojoules per kilogram of potatoes and water. A threshold value is required for the field strength to create holes in the membranes. Think of it this way: In early potatoes, say in the first six or seven months of the season, the cell pressure is high and they are hard. To drill the holes in the membranes in the first place, you need a higher field strength during that time than during the last five or six months of the season," De Boevere says. "The generators we use have an output voltage, in our case 30 kilovolts, that creates a certain field strength in an opening between the electrodes. The pulsed current flows from a plus electrode to a minus electrode. Between them is the mixture of potatoes and water. Since the Pulsemaster systems have a higher output voltage and more specific energy, the customer has more degrees of freedom to choose the right treatment throughout the year. So you can adjust the field strength at the beginning or end of the season to the different hardness levels of the potato."



Potatoes exiting the PEF installation on the transport belt, after the single-second PEF treatment.

Short residence time

"A sufficiently high specific energy keeps the holes in the membranes open," he continues. "The entire treatment occurs within one second. If the potato has been treated strongly, the drilled holes will stay open for hours. If the treatment is too weak, if you have barely reached the threshold for field strength, or if there are not enough kilowatts, the holes will close again. After all, the potato is a living product." The total residence time of the potato in the PEF transport unit is 30 seconds, according to De Boevere. "Within half a minute, the potato is fed in, drops into the water, is transported by a belt through the treatment chamber, where it is treated within a second, and then carried out again. This eliminates problems that lead to a production line breakdown in a conventional plant due to the preheater."

AGRISTO and PEF

At the end of 2020, potato processor Agristo and Pulsemaster entered into an agreement for the sale of two additional 100 kW Pulsed Electric Field systems. Agristo is based in Belgium and Holland, operates in the potato processing industry and has a wealth of Pulsed Electric Field experience within this industry.

"PEF technology not only improves the quality of potatoes for further processing into frozen fries," explains Ruben Devos, Process Innovation Manager at Agristo. A better cutting method also benefits the quality of the fries on the plate. Ten years ago, problems with the potato preheater were the direct reason for the first investment in the innovative Pulsed Electric Field technology.

State-of-the-art PEF technology

Currently, Agristo has a total of four Pulsemaster PEF systems for the production of French fries: one at the Tilburg plant in the Netherlands and three at the new Wielsbeke plant in West Flanders. "At the end of last year, we started up two new 100 kW Pulsemaster PEF systems at the new Wielsbeke plant and at the Tilburg plant," Devos continued. "We chose the latest state-of-the-art PEF technology from Pulsemaster and adapted the production line."

Better cutting quality

"The pulses from the pulse generator create very small holes in the membranes of the potato cells, which reduces the cell pressure in the potato," explains Ruben Devos. "This results in a better cut quality of the potatoes for the production of the fries, which benefits the quality of the fried fries," Devos said. "The surface of the fries is smoother, without cracks, thanks to PEF, which means the fries absorb less fat. In addition, the yield is higher because less potato starch is lost and the fries break less. Other benefits include better texture of the fries, according to Devos."

They are also crispier. In addition to the better quality of the fries on the consumer's plate, the innovative technology also offers several process advantages over the pasteurizer, which was previously used to preheat the potatoes before cutting. "For example, the PEF system is more compact and easier to control. When the PEF system is turned off, the process stops immediately," Devos says. "Compared to the pasteurizer, much less product is lost in the event of an incident or malfunction."

In addition, according to Werner Kohorst, Technical director Pulsemaster, energy savings are an important, positive side effect of using PEF technology in the processing operation, which is certainly an important factor given the current rising energy prices. "Compared to conventional energy consumption, PEF is a much more efficient way to treat potatoes at the beginning of the production line. There is no dwell time in the preheater, and energy consumption is lower. That is one of the advantages of this technology," summarizes Werner Kohorst. In addition, a company with a PEF system not only saves energy, but also follows the general trend toward CO2 reduction. "Big, well-known names in the potato processing industry are busy reducing CO2 emissions. They are setting up production lines for the future, and of course they have thought this through. PEF technology is an important, good step forward in this regard. PEF technology is a form of pulsed power that uses a generator to create a pulse that is sent into the treatment chamber. You only consume energy at the moment you send the pulse, so there is no constant energy consumption. What's more, the treatment takes less than a second," explains Werner Kohorst. As a practical example, he cites the decision by major customer McCain to install a Pulsemaster PEF system at its plant in Smithton, Tasmania: "The investment in 2021 was part of this French fry manufacturer's commitment to produce more with less energy. Water consumption was reduced by more than 100,000 liters per day last year. In addition, the PEF system at this plant will save around 276 tons of CO2 per year and reduce energy consumption by around 33,000 gigajoules."

Proven scalability

The innovative Dutch-German company Pulsemaster combines years of unique experience with Pulsed Electric Field technology. The production facility is located in Hapert, Brabant in the Netherlands. Pulsemaster offers worldwide support for its customers. In Lohne (Oldenburg), Lower Saxony, Pulsemaster has an office and a production facility for the German market. Thomas Rohe, Engineering director Pulsemaster, comments,

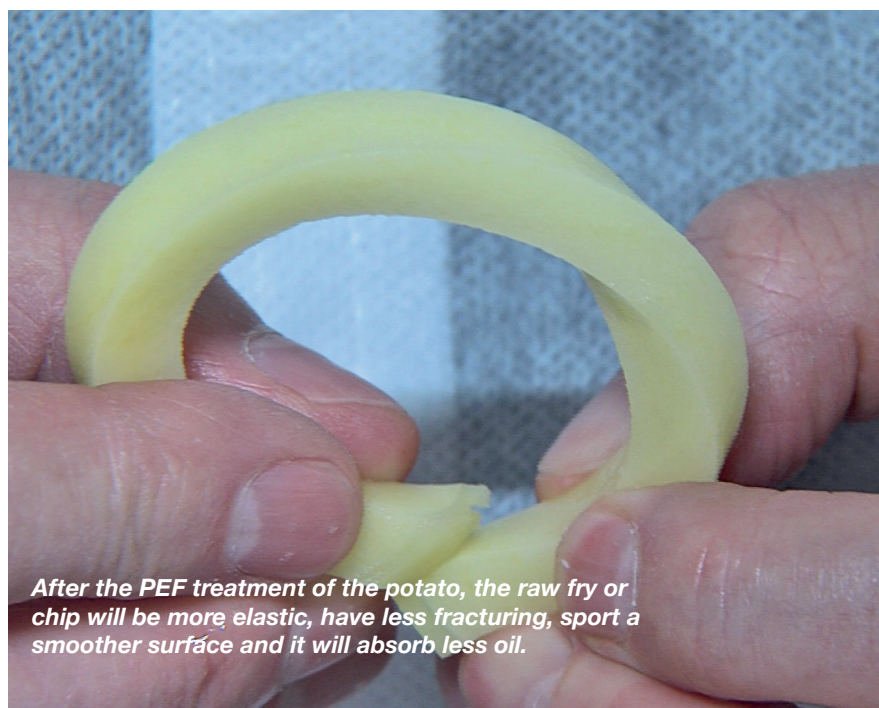
"Our PEF systems are fully integrated and modular systems for either cell disintegration of solids or microbial inactivation of liquids. For example to make high-quality juices and smoothies, with guaranteed food safety and sound commercial benefits like longer shelf life. Through the use of PEF, taste, smell and colour of the juices are enhanced. Pulsemaster can supply a range of robust PEF systems, covering a wide power range per system. Each Pulsemaster PEF system is built with the highest quality German and Dutch engineering to withstand continuous operation in Industry. "Currently, the payback period is within one year. The technical lifetime is longer, of course, but in terms of economic lifetime, we are dealing with an industry that wants to recoup its investment within one year. At the moment, with the high energy prices, this is certainly not a problem," Thomas Rohe summarizes.

Better quality

Drilling holes in the potato cell membrane has advantages for further processing. It also reduces energy consumption and CO2 emissions. And what does the French fry producer get out of it? "A higher overall yield and a better quality product that he can sell at a better price. Thanks to the PEF treatment, the potatoes are cut with an optimal potato texture. This results in a significantly lower percentage of breakage of the French fries during further processing. A conventional French fry line with preheater may have 2.5-3 percent breakage. Processors can expect on average less than 0.5 percent breakage of fries after PEF treatment of raw potatoes. In the world of French fries, the longer the fries, the more the customer is willing to pay," explains De Boevere.

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After the PEF treatment of the potato, the raw fry or chip will be more elastic, have less fracturing, sport a smoother surface and it will absorb less oil.