

## The Cutting Edge of...Organic Substrates

Polyethylene furanoate (PEF) is a very exciting material that is 100% bio-based and exhibits properties better than PET in some aspects.

The chemistry behind PEF revolves around converting organic molecules into FDCA (Furan Dicarboxylic Acid). FDCA is a precursor molecule that can then be reacted to make polyamides, polyurethanes, and polyesters. The FDCA, in this case, is reacted ethylene glycol to make the PEF polymer. There are several easily searchable websites that can illustrate this reaction.

The bottled drink industry has been very interested in finding products that are considered bio-based, are recyclable, and have properties similar to if not better than PET (Polyethylene Terephthalate), but with no significant cost increase. PEF exhibits better barrier properties for O<sub>2</sub>, CO<sub>2</sub>, and H<sub>2</sub>O than PET, and it has a higher T<sub>g</sub> and modulus in side-by-side comparisons. These properties also make the material attractive for printed electronics and roll-to-roll manufacturing conditions. One critical property for this flexible substrate is that it can withstand temperatures around 150°-180°C without warping or shrinking. This makes it more diverse in the materials that it can accept for roll-to-roll manufacturing when compared to PET with a temperature tolerance of around 120°C.

With all of the material's advantages, the real question boils down to, "How much does it cost?" It is currently difficult to tell what the cost will be for this material. The companies that produce the material recently made deals with major partners to ramp up production over the next couple of years. With the financial backing of the partners, mass production of PEF can ramp up fairly quickly leading to rapidly reduced production cost in the medium term. Both the use of organic feedstock for the production of the precursor material and being insulated from oil-price fluctuations, have the potential to greatly reduce manufacturing costs, as well. Time and the market will dictate the final price of this material, but it should be one to watch for in the near future.