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New Polymers and Polymer Materials based on Plant Oils

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For last few decades industry is looking for new oleochemical materials as an alternative to crude oil-based counterparts. Since the early 90s renewable raw materials, most commonly vegetable oils, became increasingly attractive for making oleo-based materials, particularly biobased polymers. Much attention is being paid to design of biobased polymers from renewable resources as a promising platform to provide new materials with industrially viable properties and a positive environmental impact. Some of the biobased polymer materials can surpass existing petroleum-based polymers in various applications on a cost-performance basis. Although the dependence of many fields of industry on a crude oil is still high, there is a growing economic and environmental pressure on manufacturers to employ renewable raw materials. The demand for materials based on oleo-based feedstocks grows at the expense of petroleum-based materials.

At North Dakota State University, new one-step method converts fatty acid esters from soybean oil into novel bio-based acrylic monomers for free radical polymerization was recently developed. These monomers can be applied directly in the production of polymer emulsions (latexes) that utilize acrylic monomers and polymers. The monomers offer unique functionality due to the nature of internal double bonds, which (i) allows forming linear macromolecules, (ii) allows "on-demand' cross-linking of macromolecules, and (iii) provides an ability to tune the final material performance, including hydrophobicity. Novel bio-based polymer emulsions are fabricated from soybean oil-based monomer and styrene (St), vinyl acetate (Vac), methyl methacrylate (MMA), and their potential for use in coatings, particularly, adhesives, specialty paper coatings, etc. is investigated. It is expected bio-based polymer emulsions can broaden an opportunity to substitute synthetic petroleum-based polymers in materials without sacrificing materials performance and additional costs.

Polymers from soybean oil vinyl ether monomers are another example of technology developed at NDSU. These monomers, particularly, 2-(vinyloxy)ethyl soyate, 2-VOES, can undergo copolymerization to yield copolymers promising for a variety of polymeric materials, including surfactants for personal care market and sizing agents for paper making. To this end, non-toxic soybean oil-based polymeric surfactants (SBPS) were synthesized from 2-VOES as hydrophobic portion and hydrophilic portion based on ethylene glycol units. SBPS provides excellent foaming, hair cleaning and conditioning of model shampoo formulations. SBPS-based model shampoos meet major requirements of multifunctional shampoos, including mild and efficient detergency, foaming, conditioning, and aesthetic appeal. In general, the model SBPS-based shampoos are found to be comparable with the commercial shampoos.