RadTech UV/EB 2012 Conference Preview

A UV-Curable, Grease-Resistant Coating Comprised of GRAS Components

By Sally Ramsey

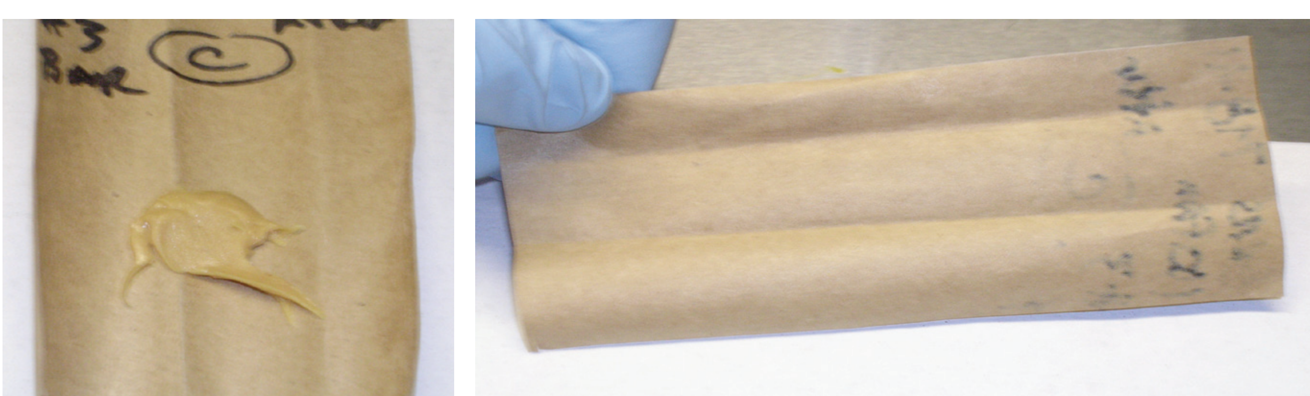
There has been a continuing push in the UV-curable community to develop products for food contact. The RadTech Food Contact Alliance has addressed this problem through FCN 772. However, coatings, inks and adhesives so formulated are permitted only limited amounts of extractables. In addition, only members of the Alliance and their customers may claim clearance for materials and/or formulations covered under FCN 772.[1] Many businesses may find these requirements difficult to meet. Coatings created from foodstuff materials that are generally regarded as safe (GRAS) under 21 CFR 175 would create no such difficulties.

The inspiration for this idea came from the irradiation of foods. The first petition for treatment of foods by irradiation was submitted in the 1960s[2]. A task group established in 1981 concluded that studies with irradiated foods do not show adverse toxicological effects.[3] Nonetheless, over the years there has been considerable concern over the effects of ionizing radiation on foodstuffs. A study in 2000 explored the structural changes (such as crosslinking) induced in ovalbumin, ovomucoid and ovotransferrin by the effect of oxygen radicals generated by gamma radiation.[4] It occurred to this researcher that if such changes could be induced by the use of ionizing radiation, perhaps similar changes could be induced with ultraviolet (UV) radiation.

In addition to food contact concerns, another reason for the use of foodstuffs is increasing public demand for more nonpetroleum-based products. Bio-based content is of increasing popularity. Proteins containing the amino acid cysteine contain S-H groups. Albumin is one such protein. While most familiarly found in animal products, albumin and other proteins may be extracted from vegetable products as well. S-H bonds from cysteine may be oxidized to form S-S bonds. Natural proteins are usually tightly curled. Such a structure may shield S-H bonds from reactions.

A protein may be uncurled with a GRAS mild acid. Proteins in powdered form may be mixed with a mild acid and dispersed in water.

Special attention was paid to the development of grease resistance. At present, bags for greasy foods (such as dry pet food) use barriers such as polyethylene to prevent the migration



Peanut butter on kraft paper (left) and the reverse side showing no oil penetration (right).

of grease to the outside of the bag. Using the protein mix as the basic film, various additives were used to block such migration. Since the creasing of bags may crack a coating and allow grease to pass through, all testing was done on creased paper. Some samples were creased prior to coating and some samples were creased after coating. A kraft paper, such as that used in pet food bags, was used for test purposes.

A number of additives were tested. Xanthan gum was incorporated into some formulations. An emulsifier was also added to some formulations. An edible starch was used as well. The purpose of the incorporation of the starch was to adsorb oil and grease so that it would not penetrate through the paper substrate. A powdered dried vegetable was used in some formulations to provide an additional cellulose barrier. The carrier was water. A mild GRAS acid salt was employed to relax the protein structure.

Coatings were applied by drawdown using either zero or #3 bars. Curing was done at either 100 ft./min., 150 ft./min,. or 200 ft./min. using a 400 WPI Fusion lamp with an "H"-type bulb.

Peanut butter, 3-in-One Oil® and canola oil were used as test reagents. These three substances were allowed to sit directly on a crease in the coated paper for 24 hours. Absorbent paper was placed beneath the test samples to detect penetration.

Samples of coatings were additionally tested for abrasion resistance using a Danilee Sutherland rub tester with a corrugated cardboard receptacle, a 4-lb. weight and a speed setting of 2. No liquids were added.

Conclusion

Grease-resistant, UV-curable coatings may be formulated from GRAS components. Grease resistance shows a high dependence on a sufficient quantity of starch in relation to the amount of protein. The addition of xanthan gum and powdered vegetables also contribute to grease resistance. The most successful coatings contain protein, gum, starch and may contain powdered vegetable. These coatings also show a high degree of resistance. Even coatings that show a lower degree of grease resistance demonstrate abrasion resistance.

If you'd like to learn more, Ramsey will be discussing this further during her end-user presentation at the upcoming RadTech UV/EB Technology Expo & Conference 2012, April 30-May 2, at the Hyatt Regency Chicago, Chicago, Ill. Details are available at *www.radtech2012.com*.

References

1. Radtech Resources Page, *http://radtech.org/whats_new/FCN.html* (accessed 7/23/2009)
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