

# Silicone coatings offer new opportunities for food contact paper performance

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The food industry continues to evolve as a diverse and sophisticated entity, providing an expanding range of products in developed countries as well as emerging economies. Global consumers depend on packaging technologies to keep pace with innovation in the variety of food products available for an array of cultures. Meanwhile, food producers are creating distinctive ways to package food for preservation, shipping and storage.

## Release papers for food contact

Two primary paper applications exist where food contact is required. The first is the general category of food release liners, where the major function of the paper is to perform with easy and clean release from the surface of processed food (figure 1).

Food release liners can be designed for single or multiple use, in professional applications or for the home market. Reusable baking papers, interleaves or single-use papers fall into this category.

The range of uses for release liners in general has led to a significant global market: in 2010, total global release liner production was approximately 2.40 million tons.<sup>a</sup> In the food industry alone, use of silicone-coated paper for food applications has doubled in less than five years, now representing 81% of food release applications, and about 178,000 tons per year.<sup>b</sup>

Another family of papers designed for food contact is greaseproof and grease-resistant papers. Applications for this type of treated paper include the packaging and protection of all types of greasy food, including wet and dry products. Greaseproof and grease-resistant papers are commonly used with fresh food, fast foods and snack wraps, bagged and boxed items, pet food, microwave cooking products, margarine and butter, and bakery products.

<sup>a</sup>The Future of Specialty Papers to 2015, Pira International Ltd. (2010).

<sup>b</sup>Specialty Papers and Paperboards Global Sourcebook, Alexander Watson Associates (2010) and Dow data.

Figure 1. Use of silicone-coated paper continues to grow in the food industry.



## Greater opportunity for silicone

In addition to their broad use in food release liners, silicone coatings hold potential for use in greaseproof or grease-resistant papers. The majority of materials used for greaseproof packaging are plastic-based, where primary applications are in the fresh, fast-food and pet food markets. Only 26% are paper-based, and of that segment, only 43% represents chemically-treated paper, including use of waxes and fluorochemicals.<sup>c</sup> Although plastic-based applications are growing twice as fast as those using paper, recyclability is increasingly viewed as important by consumers. This preference indicates is a primary advantage of paper and board.

In recent years, several market trends have influenced the growth of various food contact papers. In addition to economic drivers the food contact segment has been driven by environmental considerations, both on the part of manufacturers and consumers.

**Figure 2. Bakery and cooking paper provides ease-of-use application with its non-stick surface and easy clean-up.**



Due to concerns over toxicity related to incineration, the market has shifted away from heavy metal-based paper coatings such as chromium, which was broadly used in the bakery paper segment. Meanwhile, interest also has increased with regard to monitoring long-term exposure to perfluoroalkylated substances because of suggested health risks. Several initiatives have encouraged reduction in the use of fluorine-based substances on a voluntary basis. Although systems based on the use of fluorochemicals have been dominant in the grease-resistant paper markets for many years, other options are available and are likely to become more common if resistance to the use of fluorochemicals increases further. Some industrial users have already replaced fluorochemicals, while others have announced their intent to do so in the future.

Even recycling issues with wax-coated paper have come to the fore. Because the waxes used are not biodegradable, additional chemistry is required in terms of wetting agents and dispersants to prevent buildup of deposits over time.

Economic drivers include growth of the fast food and processed food segments, along with the demand for greater speed. These changes are triggered by urbanization, shifts in eating habits and a changing and growing population. Responding to these differences has become in part an ease-of-use approach, where greater use of food contact paper leads to greater efficiency. For example, with the use of food contact papers, cleaning may not be required on surfaces that were in contact with food after its heating or baking.

Trends of this type continue to drive changes in the coated paper industry. Silicone coatings for bakery papers are becoming more popular, particularly in the EU, where greater than 90% of the market has switched. In contrast, only a minority of the American market has made the change, due in part to less demanding requirements in terms of release and greater popularity of single-use papers.

The change to silicone-coated paper does not necessarily lead to an increase in cost of use because of factors such as coat weight reduction and better performance. An increasing focus on sustainability, including recyclable liners, renewable materials, and energy consumption efficiencies also is driving the market toward great use of silicone-coated papers. Geographic expansion, primarily driven by developing markets in India, China and South America, has led to an increase in food processing, with resulting greater demand for performance and cost efficiency in food contact paper. In developed countries, a reduction in average household size (due to more single-person households or single-parent families) has resulted in more individual households and greater use of packaging.

In summary, there are several drivers for change in the food contact paper segment. The search for higher product value by paper mills encourages the development of value-added products. In response, the success of a new product will be determined not only by its cost in relation to barrier performance, but also by its ease of application (i.e., low equipment cost) and compatibility with existing converting processes—or the ability to use new technologies on existing equipment. Predictability and consistency of performance are linked to any potential advances.

The case for environmental responsibility and renewability argues against wax and film barriers, while opening the door to more high performance materials. A growing sense of corporate social responsibility in terms of sustainability, renewability, recyclability, and waste management—in short, a stronger concept of cradle-to-grave responsibility—can alter the entire continuum of manufacturing, waste disposal, and recycling.

<sup>c</sup>Dow data

## Silicone emulsion technology in the marketplace

Silicone coating technologies have a long history, and with time, they have become more appropriate for food applications.

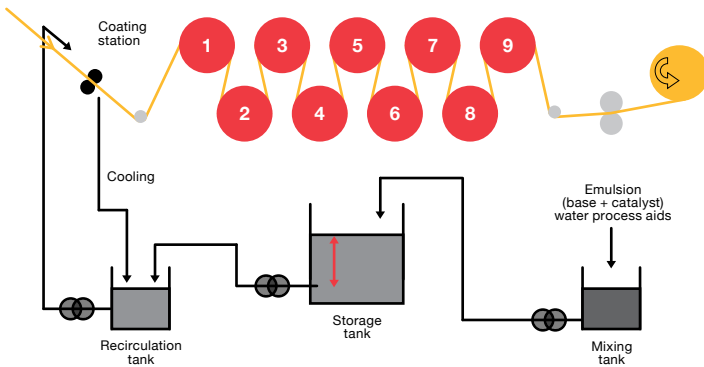
The first, and oldest, technology is solvent-based coating, which depends on using a solvent as a carrier to deposit silicone on the paper substrate. This approach is no longer a preferred method, and is gradually being phased out of use due to safety concerns associated with some solvents. Another method, solventless coating, is primarily used in labeling applications.

Emulsion technology is the preferred coating method for a variety of applications including food contact. This technique is based on a platinum-catalyzed reactive system. This method produces low levels of byproduct and is in fact commonly used for curing silicone for medical applications, where safety and purity are sensitive issues.

In release coating applications such as food and labels, the water-based silicone coating system consists of two reactive parts that are combined and mixed just before application. Part A of the emulsion coating contains the polymer and a cross-linker. Part B contains the platinum catalyst diluted in a polymer for easy handling.

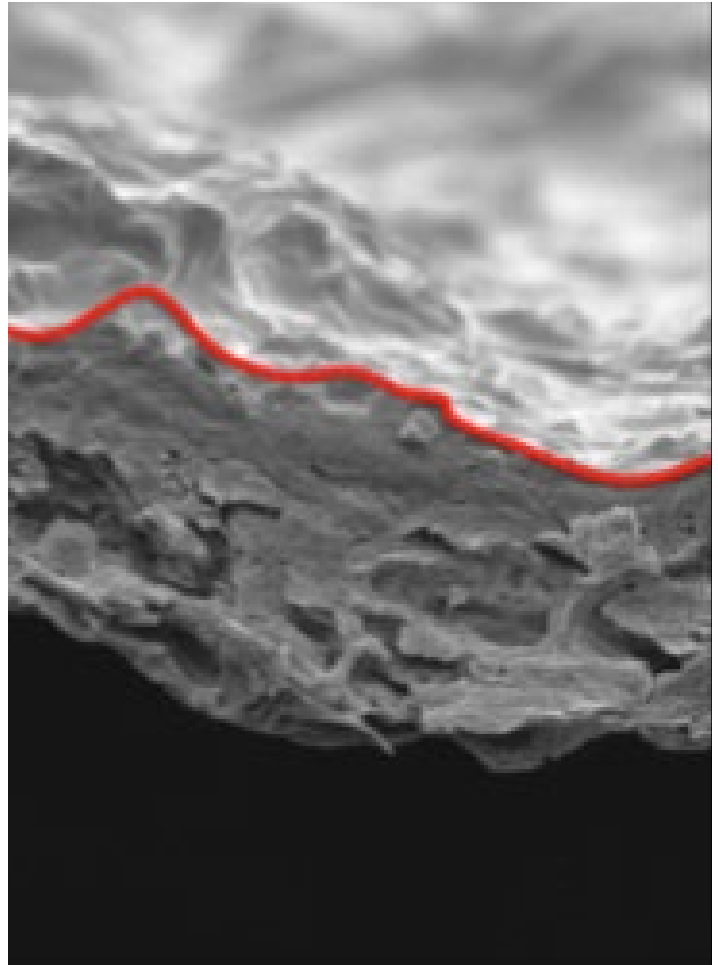
Application of the silicone emulsion is easy and can be done online as part of the paper manufacturing process, eliminating the need for a separate process by a converter. As part of the online process, the reactive silicone emulsion is applied to the paper before the last drying step, and the silicone is dried and cured in the final process stage (figure 3).

**Figure 3. A siliconization step can easily be integrated at the end of the paper manufacturing process. Figure courtesy of Dow.**



Paper coated with as little as 0.30 g/m<sup>2</sup> silicone offers outstanding release properties and multiple uses. The resulting waterproof material is microwavable, repulpable and compostable. Figure 4 shows a cross-section of such a paper.

**Figure 4. Cross-section of silicone-coated paper. Red line indicates paper surface with coating. Photo courtesy of Dow.**



Several properties of siliconized paper make it useful for food contact and also show potential for use in greaseproof applications. For food release, key characteristics of silicone are its outstanding release properties, without sticking. Silicone coated paper has a low Cobb<sub>60</sub> value of approximately 8 to 15 g/m<sup>2</sup>, which indicates a high resistance to absorbing water. A low value of this type is primarily important for frozen food processing. Greaseproof paper requires good resistance to grease over time, also important for packaging. A silicone-modified coating can give a kit test value up to 12.

## Conclusions

The food contact segment of the industry is a high growth market segment, driven by economics, changing populations, technology advances and environmental concerns. Silicone release papers are primarily used for bakery and food release operations, and market penetration of the silicone application is growing. The appropriate silicone technology for producing greaseproof papers is established and holds promise for the food industry, with the added benefit that silicones already comply with requirements for food-contact applications.

Given the success of silicone technology for release papers, considerable opportunity exists for technology transfer to greaseproof applications and further penetration into the packaging market.

Dow invites your interest in exploring options that would serve your needs. For more information, contact your local Dow representative.

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