

# Safe and Reliable Defoamer Used in the Manufacture of Products All around Us

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Products that come in contact with the human body or food, such as clothing, food packaging and rubber gloves, must be highly safe and reliable. In such applications, products have been approved for safety by the U.S. Food and Drug Administration (FDA) and other national agencies. However, as safety awareness has increased in recent years, some countries and industries have imposed even stricter requirements. At the same time, the globalization of industry has led to the export of products manufactured in Japan to the rest of the world and the local manufacture of the same products overseas, increasing the need for products that can be used safely in a wide range of countries and applications. SAN NOPCO has been developing industrial defoamers for a wide range of industries for more than 50 years. In recent years, in response to the growing social needs described above, SAN NOPCO has developed defoamers that not only function as defoamers, but also can be used safely and reliably regardless of the application (i.e., universally). In this paper, we will discuss the outline of defoamers and then



**Photo 1** Reaction tank about to overflow

introduce "NOPTAM 1790", a defoamer for food contact materials, as part of these "universal defoamer" efforts.

## Bubbles in the manufacturing process

Bubbles are gases surrounded by a film of foam. In the case of water, the bubbles burst as soon as they reach the liquid surface, but in the case of solution of water-soluble resins, surfactants, various dispersants, etc., they adhere to the gas-liquid interface, which stabilizes the foam film and prevents it from bursting. As in detergents, shampoos, beer, etc., stable foam is useful in many aspects of life. On the other hand, in the manufacturing industry, foam can have a negative impact on the quality of the product and can be a nuisance that reduces production efficiency. Problems caused by foam



**Photo 2** Coating film defects

include overflow from tanks and equipment and coating film defects (**Photos 1 and 2**). To prevent such foam problems, defoamers are used in a wide range of industries.

## Mechanism of action of defoaming agents

Defoamers are mainly composed of hydrophobic and low surface tension liquids such as mineral oil and silicone oil, and when dispersed in the foaming liquid in the appropriate particle size, they exert a defoaming effect. The defoamer particles dispersed in the foaming liquid have a preference for the gas-liquid interface due to their high hydrophobicity, and they easily immerse in the liquid film (foam film) that separates the air bubble from the outer air phase, as shown in **Figure 1**.

The presence of defoamer

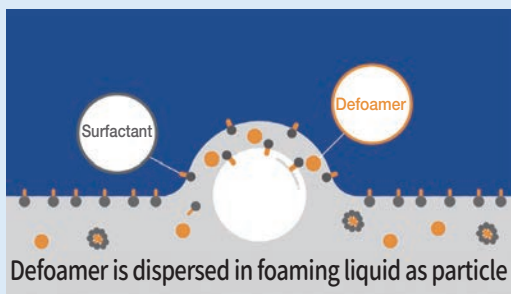


Fig. 1 Defoamer in foaming liquid

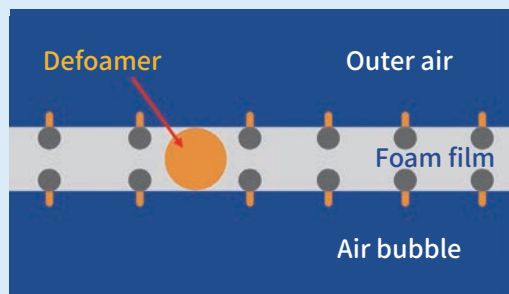


Fig. 2 Defoamer remain in the foam film

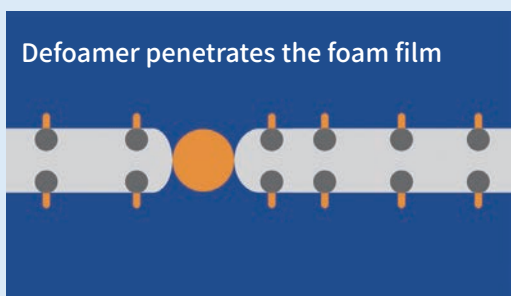


Fig. 3 The defoamer penetrates the foam film

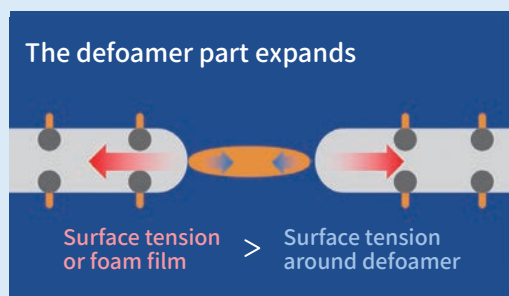


Fig. 4 The defoamer part expands

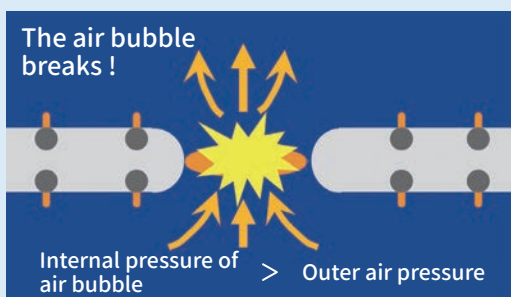


Fig. 5 The air bubble breaks

particles in the foam film is the first step in achieving the defoaming effect.

Figure 2 is a magnified image of the foam film in Figure 1. As can be seen, the thickness of the foam film is close to the particle size of the defoamer, it penetrates the foam film to form a structure as shown in Figure 3, because the defoamer is hydrophobic (i.e., it prefers

air to water). As the defoamer penetrates the foam film, the surface tension around the defoamer becomes lower than the surrounding area (foam film strength decreases), the foam film is pulled down by the contraction force. The defoamer expands rapidly, causing the foam to break. (Figures 4 and 5).

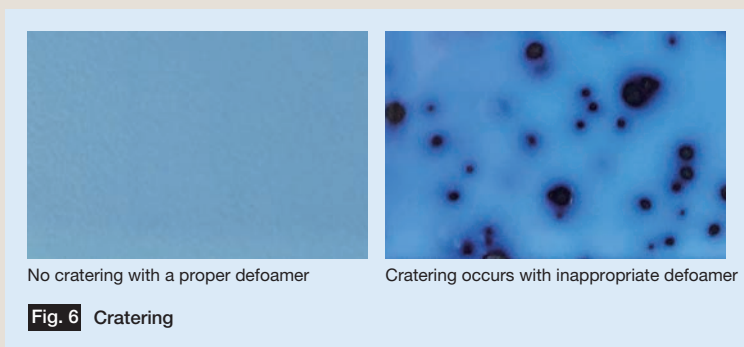
Based on the above mechanism of action, the defoamer must meet the following requirements

#### 《Requirements for defoaming agents》

- (1) The particles must be dispersed (not dissolved) in the foam solution with appropriate particle size. (Do not dissolve).
- (2) Surface tension must be sufficiently low compared to that of the foaming liquid.

#### Side Effects of Antifoaming -Cratering problems

While the defoamer thus performs its function of eliminating foam, it is also important that the defoamer does not affect the performance



**Fig. 6** Cratering

of the final product. For example, the localized expansion of the defoamer in finished coating film of paints, coatings, etc. causes coating defects called cratering. Cratering occurs when the dispersed particle size of the defoamer is larger than necessary (Fig. 6). On the other hand, if the dispersed particle size of the defoamer is too small, it will be difficult to penetrate the foam film and the defoaming effect will not be reduced. Therefore, to achieve the balance between the two, it is necessary to disperse the particles with "appropriate particle size" as described in the defoamer requirement (1). The solid component, called

the core material, is often used in defoamers to disperse the low surface tension liquid component (defoaming component) at the appropriate particle size. Depending on the application, conditions, and material limitations, different combinations of core materials and defoaming components are used (Figure 7).

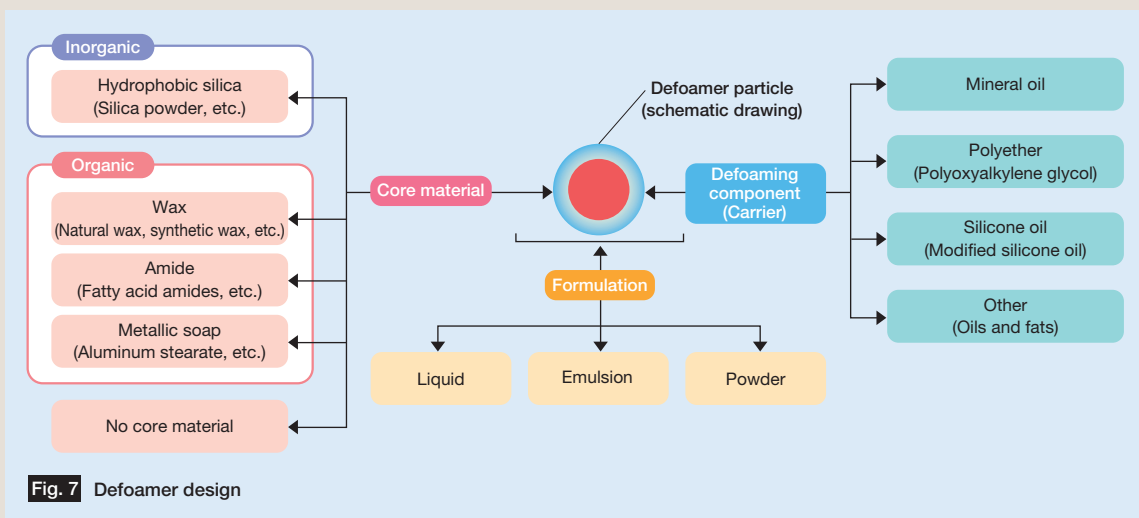
### De-plasticization and regulation of food contact materials

In recent years, as efforts to reduce the use of single-use plastics have spread worldwide, functionally coated paper is being used for beverage cups, straws and food packaging bags (Photo 3) where plastic



**Photo 3** Food packaging products

was previously used. These coatings are required to have very high functionality. In the case of food wrapping paper, for example, in addition to a high level of safety that does not pose a health risk when in contact with food, the paper must also provide a barrier to odors, acids, and moisture to preserve the taste and quality of the food inside. However, if the finished coating material has defects caused by foam, or if it has craters caused by the defoamer, the barrier properties of the finished coating material are meaningless. Therefore, a high quality defoamer that combines both defoaming and low cratering properties, and



**Fig. 7** Defoamer design

is also safe to use, is one of the essential materials for the design of such coatings. For food contact materials, there are a number of regulations in place around the world to ensure consumer safety. The substances that can be used are subject to these restrictions. In the United States, the U.S. Food and Drug Administration (FDA) has long operated a positive list system (a system that lists substances that can be used), and it has become the standard in this field. In recent years, Japan, China, the EU and other countries have also begun to adopt the positive list management rules one by one. In order to expand business globally, it is important to have products that comply with a wide range of these laws and regulations.

### SAN NOPCO 's defoamer for food contact materials

SAN NOPCO has long been involved in the development of defoamer technology for paper

coating, and by utilizing the technologies it has cultivated over many years, NOPTAM 1790 has been developed as a defoamer that complies with a wide range of regulations related to food contact materials. NOPTAM 1790 uses only raw materials whose safety is widely recognized, and complies not only with U.S. FDA regulations, but also with regulations in Japan, China, and the European Union (**Table 1**). NOPTAM 1790 also contains minimal amounts of polycyclic aromatic hydrocarbons (PAHs), a substance that has raised safety concerns in recent years<sup>1)</sup>. PAHs are organic compounds consisting of two or more aromatic rings, and regulations and standards are being developed to reduce PAHs in articles that are ingested or come into contact with the human body<sup>2)</sup>. NOPTAM 1790 has been designed with PAHs in mind, including the use of highly safe raw materials with extremely low levels of PAHs.

### Future developments

The safety movement is expected to spread to more industries, countries and regions in the future. In addition to safety, societal needs have become more diverse in recent years, including the use of sustainable and ethical raw materials and biodegradability, which allows for rapid degradation when released into the environment. SAN NOPCO will continue to develop "universal defoamers" that can be safely used by a wider range of people in a wider range of regions and applications in response to changing social needs, thereby contributing to human health and environmental protection.

### References

- 1) International Agency for Research on Cancer (IARC): Agents Classified by IARC Monographs <http://monographs.iarc.fr/ENG/Classification/index.php>
- 2) Food Safety Commission Fact Sheet [https://www.fsc.go.jp/sonota/factsheets/f05\\_pahs.pdf](https://www.fsc.go.jp/sonota/factsheets/f05_pahs.pdf)

**Table 1** Compliance Status of NOPTAM 1790 with Food Contact Material Laws and Regulations

NOPTAM 1790		
Food Contact Material Laws and Regulations	U.S. FDA 21CFR	Compositionally compliant* (176.210 et seq.)
	China GB9685-2016	Compositionally compliant* (A2, A5, A6)
	EU directive No.10/2011	Compositionally compliant*
	Japan Food Sanitation Act	Compositionally compliant*
Other	PAHs Polycyclic aromatic hydrocarbons	≤ 1ppm

\*Compositionally Compliant = Ingredients are on the positive list This does not mean to be safe for food contact applications is guaranteed.

Please contact our company sales representative when handling our company products. Also be sure to read the "Safety Data Sheet" (SDS) in advance. It is the responsibility of the user to determine the suitability and safety in the intended use.

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