ThreeBond
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Industrial Cleaning Agents, Brake and Parts Cleaner

Introduction

Cleaning can be defined in a number of ways we remove stains with a liquid or gas, whether rinsing, washing or cleansing. By “liquid” we mean something like water or a solvent, and by “gas” we mean things like compressed air or nitrogen gas. There are many types of stains to remove, from sebum and sweat in ordinary environments to paint and oil deposits, and even contamination from metal powders. In order to remove these efficiently, it is vital to select and use the right combination of cleaners and cleaning methods for what is being removed.

At ThreeBond, we offer a broad lineup of cleaning agents for part used in industrial application, and have released a wide variety of products since our founding. One of our main products is brake and parts cleaner used to clean are around automobile brake parts.

In this article, we will discuss the basic concept of cleaning, our industrial cleaning agents and our brake and parts cleaner.

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1. Stain Classification and Cleaning Performance

In order to efficiently remove the various kinds of stains around us, it is important to select cleaning methods and agents suitable for the type of stain to be removed, as well as to appropriately select and set the cleaning equipment and usage conditions. Therefore, it is necessary to carefully observe the type and condition of the stain to determine the working environment in which cleaning is to be performed. Stain types can be broken up into hydrophilic, hydrophobic and mixed (Table 1).

For example, organic solvent-based cleaning agents are less effective on hydrophilic stains, while water-based cleaning agents are less effective on hydrophobic ones. In addition, mixed stains are a combination of the two, so they cannot be cleaned with a solvent-based or water-based cleaning agent alone. Furthermore, when selecting a cleaning agent, you must first thoroughly check laws and regulations such as the Industrial Safety and Health Act and the Fire Service Act (in the case of Japan) as well as possible effects on the human body and the cost.

2. Cleaning Methods

Cleaning methods can be broadly broken down into chemical and physical (Table 2).

Chemical cleaning removes stains through chemical mechanisms such as dissolution or decomposition. The cleaning agent is designed as needed for the intended purpose by combining multiple components, such as solvents, acids, alkali agents and surfactants.

Physical cleaning, on the other hand, removes stains through polishing with materials like cloth, or by spraying liquid at high pressure. By combining chemical and physical cleaning, it is possible to improve performance, such as when applying a cleaning agent then wiping with a microfiber cloth or some other high cleaning performance cloth.

3. Components of Cleaning Agents

Cleaning agents primarily consist of the following components.

3-1. Solvents

These are liquids used to dissolve a substance. Water is generally used for hydrophilic stains, while organic solvents such as hydrocarbon, alcohol, chlorine, bromine and fluorine are mainly used for fats, oils and other hydrophobic stains.

3-2. Acid and Alkali Agents

These are mainly used in water-based cleaning agents to adjust acidity and alkalinity. They work to change the stain to something that is easier to break down then dissolve and disperse in water. Hydrochloric acid and citric acid are often-used acids, while sodium hydroxide and carbonate are used as alkali agents.

Table 1 Stain Classification

Stain classification	Definition	Example
Hydrophilic	Dissolves in water Easily breaks down in water	Soil, mud, proteins and scale
Hydrophobic	Does not dissolve in water Does not easily break down in water	Oils and fats such as mineral oils, paints and soot
Mixed	A combination of hydrophilic and hydrophobic	Stains on outside walls (mixture of oils, fats, soil, soot, etc.)

Table 2 Cleaning Methods

Type	Cleaning mechanism	Characteristics
Chemical	Dissolution	Dissolves and removes stains
	Separation/dispersal	Separates dirt from the object being cleaned and disperses the stain in the liquid
	Decomposition	Decomposes the stain and turns it into a different substance
Physical	Polishing	Removes stains by rubbing with a cloth, etc.
	Stirring	Removes stains through convection while stirring
	High pressurizing	Sprays a high pressure liquid to remove the stain

3-3. Surfactants

Surfactants are chemical compounds that are structured of both water-compatible hydrophilic groups and oil-compatible hydrophobic groups. Depending on chemical structure, surfactants may possess wetting, emulsifying, dispersion stabilizing or solubilizing action, so various kinds of surfactants are combined to design the optimum agent for the stained to be cleaned. Through these actions, surfactants remove stains in a process of adsorption, permeation, exfoliation/micelle formation, and emulsification/dispersion (Fig. 1).

3-4. Cleaning Aids

Cleaning aids (also known as builders) are additives used in conjunction with surfactants. For example, EDTA and other chelating agents capture metal ions that hinder the function of surfactants, while silicates and similar compounds maintain the alkaline state of a cleaning agent and carboxymethyl cellulose and other cellulose derivatives are added in order to improve dispersion stability and prevent recontamination.

4. Industrial Cleaning Agents

The components discussed in section 3 are combined to design a variety of cleaning agents. Cleaning agents used in industrial applications are classified according to their components into nonaqueous, semi-aqueous and aqueous (Table 3).

4-1. Nonaqueous Cleaning Agents

Nonaqueous cleaning agents remove stains mainly through the dissolving ability of the organic solvents discussed in section 3-1. Based on the type of organic solvent used as the main component, they are categorized into hydrocarbon, alcohol, chlorine, bromine, fluorine, etc.

Hydrocarbon cleaning agents are powerful degreasers with high oil solubility, making them effective for hydrophobic stains, but ineffective for hydrophilic stains. Major hydrocarbon solvents include paraffinic, isoparaffinic, naphthenic and aromatic. These can be combined to adjust cleaning and drying performance. Certain types of solvents fall under regulations such as the Ordinance on Prevention of Organic Solvent Poisoning or the Ordinance on Prevention of Hazards Due to Specified Chemical Substances (in the case of Japan), so they may require installation of a local ventilation system or reports/notification to the appropriate organizations.

Alcohol cleaning agents are highly permeable and suitable for cleaning fine parts. They dry quickly, which makes their workability excellent. However, while their cleaning performance for hydrophobic stains is inferior to hydrocarbon detergents, they are effective for hydrophilic stains. Mixtures of hydrocarbon and alcohol cleaning agents are often used to handle both hydrophobic and hydrophilic stains.

Chlorine and bromine cleaning agents do not have a flash point and are highly effective for hydrophobic stains, particularly those that are difficult to remove with typical cleaning agents. However, they are also highly carcinogenic and environmentally hazardous, so they are less often employed in recent years.

Fluorous cleaning agents are non-flammable solvents with excellent drying performance and permeability. They also do not have a flash point. In recent years, they have attracted a great deal of attention because they are less harmful to

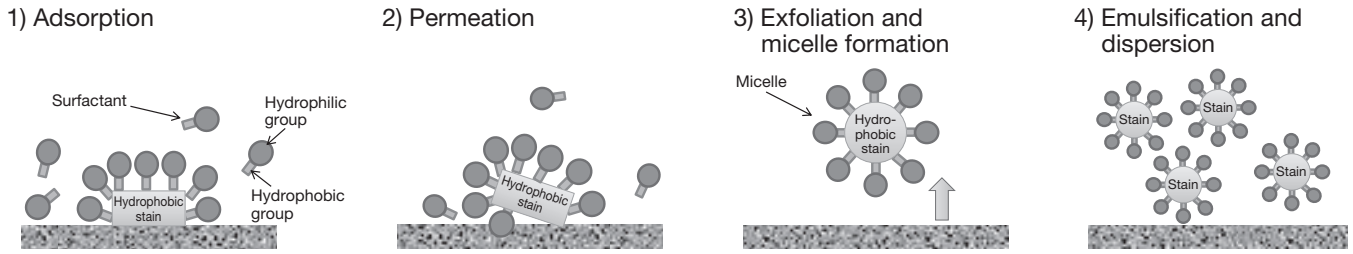


Fig. 1 Stain Removal with Surfactants

Table 3 Types of Industrial Cleaning Agents

Type	Cleaning mechanism	Components	Appropriate stain type
Nonaqueous	Dissolution	Solvent	Hydrophobic
Semi-aqueous	Dissolution, separation/dispersal	Water, surfactant, cleaning aid, solvent	Hydrophobic, mixed
Aqueous	Separation/dispersal, decomposition/reaction	Water, surfactant, cleaning aid, alkali agent, acid	Hydrophilic, mixed

the human body but enable effective and safe cleaning. Like ThreeBond 6651F, which will be discussed later, it is also possible to design cleaning agents with low ozone depletion and global warming potential.

4-2. Semi-Aqueous Cleaning Agents

Semi-aqueous cleaning agents are mainly made up of water and are composed of alcoholic solvents that dissolve in water, surfactants and cleaning aids. They dissolve and wash away hydrophilic stains with water/alcoholic solvents, while handling fats, oils and other hydrophobic stains with solvent solubility and surfactant dispersion stabilization action. They effect plastic and rubber parts very little, making them suitable for removing stains on resins that would crack and discolor if nonaqueous cleaning agents were used.

Alcohol mixes and other cleaning agents designed to be classified as non-hazardous in regulations such as Japan's Fire Service Act can be stored without concern of stipulations such as specified quantities.

However, because their main component is water, they dry more slowly than nonaqueous cleaning agents, and may require air blowers or wiping.

4-3. Aqueous Cleaning Agents

Aqueous cleaning agents are mainly composed of water and surfactants. Unlike semi-aqueous cleaning agents, they don't contain alcohol solvents, which is a major bonus as they are categorized as non-hazardous in Japan's Fire Service Act and also do not have a flash point. Their particular effectiveness varies depending on their acidic/alkaline liquidity, so they are categorized as acidic, neutral and alkaline.

Acidic cleaning agents are composed of inorganic acids such as hydrochloric or phosphoric, organic acids such as citric or malic and surfactants, etc. They clean using acid's ability to decompose, and are applied to remove scale (slightly soluble salt and water deposits) and rust. Caution must be exercised, however, because stronger acids run the risk of accelerating metal corrosion and resin degradation.

Neutral cleaning agents are mainly surfactants that do not influence liquidity. They are neutralized by combining weakly alkaline and acid compounds. They do not clean as powerfully as other agents, but also do not affect the base material being cleaned and have very little effect on the human body. They are used to remove light stains in cleaning agents for floors or tableware.

Alkali cleaning agents are composed of strong alkaline salts such as sodium hydroxide, silicate or carbonate, surfactants and cleaning aids. They clean through saponification or deacidification. They boast excellent cleaning performance for fats and oils and are widely used in industrial aqueous cleaning agents. However, as with aiding cleaning agents, they may accelerate corrosion on metal surfaces and deterioration of resin, so these possibilities must be looked into before use on the object to be cleaned. Furthermore, additional caution must be exercised because mixing acidic and alkaline cleaning agents may produce toxic gases.

Table 4 Products by Stain Type

Stain classification	Stain examples	Cleaning agent type	Product	Main applications
Hydrophilic	Soil, mud	Aqueous	TB2771D	Floor cleaning Neutral
	Protein	Aqueous	TB6658	Kitchen cleaning Cutting fluid removal
	Scale	Aqueous	TB6609	Scale removal
Hydrophobic	Mineral oils and other oils and fats	Nonaqueous	TB2706	Oil and fat removal Parts cleaning
	Paints	Nonaqueous	TB2706J	Hydrophobic stain removal Slow drying
	Soot, etc.	Aqueous	TB2777E	Floor cleaning Strong alkaline
Mixed	Stains on outside walls (oils, fats, soil, soot, etc.)	Semi-aqueous	TB6651D	Mixed stain removal Cleaning the area around automobile brakes

* ThreeBond is abbreviated to TB.
* The above is not an exhaustive list. A wide variety of cleaning products are available. Please contact our sales engineers for further information.

4-4. Our Industrial Cleaning Agents

Here, we'll summarize our products according to the stains they are effective for (Table 4). The cleaning agents listed are not a comprehensive list, so contact our sales representatives for further information.

5. Brake and Parts Cleaner

Brake and parts cleaners are indispensable in vehicle maintenance. These cleaning agents remove grease, iron powder and other stains around automobile brake parts. The shapes of these parts are quite complex, and it is vital that the cleaning agent reach even the smallest part. Furthermore, dust, iron powder and other solids are mixed in with grease, so chemical cleaning alone is insufficient. Initially, a large amount of labor is required to clean, including removing brake parts or using multiple cleaning agents and scrubbing with a wire brush.

Therefore, in the late 70s, we focused on aerosol technology that was just gaining traction to develop TB6600 (brake device cleaning agent), which combined the physical cleaning performance of CFC gas injection pressure with the chemical cleaning performance of chlorinated solvents. This made it possible to clean parts without removal or special cleaning tools, greatly improving brake maintenance workability. This product made aerosol products a common way to clean brake devices, and so we established a new field of products within industrial cleaning agents, aerosol brake and parts cleaners.

The toxicity of chlorinated solvents and the impact of CFCs on the global environment because topics of interest in the late 1980s. So, in the 1990s, we developed aerosol products that used LPG or CO_2 instead of these toxic gases, with hydrocarbon solvent as the stock solution.

The kinds of stains on brake parts continues to change with advances in engine oil, brake fluid, LLC, etc., which necessitates change in the design of the agents used to clean these parts. We continue to make improvements in response to these changes, and now have a lineup of products tailored to a variety of situations that are not regulated by Japanese ordinances on organic solvents and chemical substance hazards (Table 5).

By thoroughly understanding the work environment, laws and regulations as well as the advantages and disadvantages of each brake and parts cleaner, you can improve the efficiency automobile maintenance.

TB6602P is a general-purpose cleaner that demonstrates excellent cleaning performance and workability when handling hydrophobic stains. It uses isohexane as the main solvent for grease removal. Although low-purity

Table 5 Representative Brake and Parts Cleaner Characteristics

	TB6602P	TB6602L	TB6651D	TB6651F
Cleaning agent type	Nonaqueous	Nonaqueous	Semi-aqueous	Nonaqueous
Main components	Hydrocarbon solvent	Hydrocarbon solvent	Water Aqueous solvent Hydrocarbon solvent	Fluorous solvent
Form	Aerosol	Aerosol	18-liter can	Aerosol
Gas	LPG, CO_2	LPG, CO_2	–	CO_2
Odor	Solvent	Solvent	Alcohol	Mild solvent
Cleaning performance (overall)	Excellent	Good	Possible	Good
Engine Oil	Excellent	Good	Possible	Good
Gear oil	Excellent	Excellent	Good	Excellent
Brake Fluid	Excellent	Excellent	Excellent	Excellent
Drying performance	Excellent	Good	Possible	Excellent
Drying time	20 to 40 sec	120 to 160 sec	400 to 500 sec	20 to 40 sec
Fire Service Act classification	Class I petroleum	Class II petroleum	Non-hazardous	Non-hazardous
Specified quantity	200L	1000L	None	None
Flash point	–20°C	22°C	26°C	None

isohexane is more cost effective, permeability and cleaning performance are reduced, so we adopted the optimum purity to ensure performance. The cleaner is made up of additional solvents, including aqueous solvents, making it able to handle hydrophilic brake fluid. In consideration of workability, we made moderate adjustments to keep it from drying to quickly, an issue when using isohexane on its own. This cleaner is categorized as a class I petroleum under Japan's Fire Service Act.

TB6602L is a class II petroleum cleaning agent for when a sufficient amount of class I agent cannot be stored due to quantities specified in regulations like the Fire Service Act, or for when class I agents like TB6602P dry too quickly to suit the intended purpose. Generally, class II petroleum solvents are less dry and don't clean as powerfully as class I petroleums, and many have unique odors. We mix various solvents at the optimal ratio to create products with powerful cleaning performance that belies their class II petroleum status.

Because TB6602P and TB6602L are mainly composed of organic solvent, there are concerns that they present more of a threat to the human body than aqueous cleaning agents. Furthermore, the maximum amount that may be stored according the Fire Service Act is quite low. TB6651D overcomes both issues of safety and storage volumes. As previously discussed, semi-aqueous and aqueous cleaning agents often contain surfactants to increase their cleaning performance. These lubricate brake devices, so TB6651D does not contain them, and is instead designed as a semi-aqueous agent that cleans with only water, alcohol solvent and hydrocarbon solvent (patented).

From the viewpoint quantity specified in the Fire Service Act, ignition danger, impact on the human body and other safety concerns, more and more people have turned to products like TB6602L and TB6651D. However, TB6602P boast greater performance than either of these products in terms of both cleaning and drying, so it is important to consider both ensuring working time and physical cleaning together. Additionally, there is considerable risk of ignition as well as impact on the human body, so there is high demand from workers to develop products that clean and dry quickly while still being incredibly safe. To meet these demands, we released TB6651F (incombustible brake parts cleaner) in 2017.

Table 6 Brake and Parts Cleaner Overview

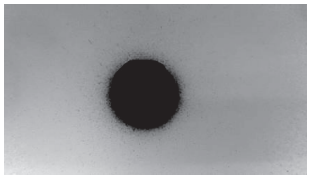
	TB6602P	TB6602L	TB6651D	TB6651F
Cleaning action	Dissolution	Dissolution Separation/dispersal	Dissolution Separation/dispersal	Dissolution Separation/dispersal
Advantages	• Excellent workability • Wastewater treatment not required • Little rust • Facilitates cleaning in gaps	• Better workability than semi-aqueous agents • Wastewater treatment not required • Little rust • Less danger of ignition than class I petroleum agents	• Handles a variety of stain types • Flash point poses little risk • Storage quantity not specified by Japanese law	• Excellent workability • Little danger to the human body • No flash point • Classified as non-hazardous in the Japanese Fire Service Act • Storage quantity not specified by Japanese law
Disadvantages	• Handles a limited number of stain types • Dangerous to the human body • Highly dangerous to the environment • May corrode some materials • Class I petroleum, so storage quantity is limited • Highly dangerous flash point	• Handles a limited number of stain types • Dangerous to the human body • Dangerous to the environment • May corrode some materials	• Wastewater treatment required • Dangerous to the human body • Dangerous to the environment • May corrode some materials	• Expensive • May corrode some materials
Cleaning performance	Excellent	Good	Possible	Good
Workability	Excellent	Good	Possible	Excellent
Fire Service Act	Class I petroleum	Class II petroleum	Non-hazardous*	Non-hazardous
Flash point	–20°C	22°C	26°C	None

* Excluded from application in the Fire Service Act

5-1. ThreeBond 6651F

TB6651F is a cleaning agent with a fluorous solvent base and nearly 0 global warming and ozone depletion potential. The propellant gas is non-flammable and utilizes CO_2, which enables highly pressurized spray for excellent physical cleaning performance. TB6651F cleans hydrophobic stains just as well or better than class II nonaqueous petroleum cleaning agents and dries as quickly as class I petroleum cleaning agents (Fig. 2).

In recent years, there have been a series of fires at automobile work sites caused by static sparks, so countermeasures are needed. TB6651F can be used safely because it does not have a flash point, so even if sparks were to occur, it would not ignite. Additionally, because it is classified as non-hazardous in the Fire Service Act, there are no issues concerning specified storage quantities (in Japan). GHS classification is also not applied, and it has less impact on both the human body and the environment than other cleaning agents, making this newest addition to our lineup of cleaning agent incredibly safe.



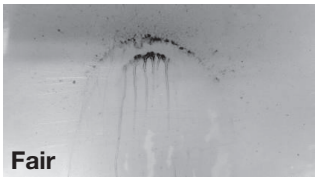
Before cleaning

TB1925 (molybdenum disulfide grease) was applied to the stain model. TB1925 was applied to SUS430 for 1 second, then sprayed with each brake and parts cleaner for five seconds, and the amount of stain removed was observed.

Excellent: Grease was completely removed
Good: Grease was mostly removed
Fair: The model needed to be wiped down after to remove the remaining grease.

TB6602P

TB6602L



TB6651D

TB6651F

Fig. 2 Representative Brake and Parts Cleaners

5-2. Recharge System

Dealing with cans is an issue when using aerosol brake and parts cleaners. After use, they must be disposed of as industrial waste, which is costly. These cans also present an issue in terms of environmental issues. To reduce both of these burdens, we have released a lineup of recharge systems for our brake and parts cleaners (Fig. 3).

The recharge system is equipment especially for refilling ThreeBond cans with new cleaning agent (patent pending). This specialized equipment is driven only with air sent from a compressor, so additional equipment, like a specialized power supply, is not required. It also is easy to use in small work spaces because it is designed so that it can be carried by a single person. The special can is capable of spray at any angle within 360 degrees, improving work efficiency by eliminating issues related to spray with only the aerosol propellant gas. It can be refilled 30 to 60 times with a single can, greatly reducing disposal costs over conventional aerosol cans.

Recharge System Can and Equipment

* The above figures show the combination of recharge system can and equipment used for non-combustive brake parts cleaner.
Different cans and equipment correspond to the various types of brake and parts cleaner, so please contact our sales representatives for further information.

Fig. 3 Recharge System Equipment and Can

Closing

In this article, we presented an overview of cleaning agents, then discussed ThreeBond's lineup of industrial cleaning agents and brake and parts cleaners. When using cleaning agents, it's important to understand the properties of that agent to use it in an optimal manner in order to maximize its effectiveness. We hope this article will help you get the most out of your cleaners.

At Threebond, we are working to create new cleaning technologies every day in order to quickly meet our customers' needs. In recent years, there has been demand for cleaning agents that are effective while also being safe for the workers using them and the environment. We will continue to focus on developing superior products in order to bring our customers products that respond to the issues of our changing times.

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