



---

# The Essential Guide to Flocculants

Helping you make an informed decision  
on selecting the right flocculant for you

 **Univar**Solutions

The following guide highlights the most frequently used flocculants on the market and how to select the right one for you.





---

## Introduction

For centuries, humanity has been utilising flocculation techniques to purify water.

From Ancient Egypt's use of almonds and alum for river cleanliness over two millennia ago, modern science saw big leaps forward with the advent of polymeric flocculants half a century ago - revolutionising industries dealing in wastewater treatment ever since. As new technologies continue to be developed today, businesses increasingly strive towards more efficient and cost-effective solutions when processing their industrial byproducts.

The following guide highlights the most frequently used flocculants on the market and how to select the right one for you.

# Deciding which class of flocculant is suitable for you



This guide discusses the five key areas to consider when choosing your next flocculant.

## **Ease of Use**

The preparation of flocculants can be challenging and time-consuming. For example, powder and emulsion flocculants must dissolve and mature for an extended period. Access to equipment such as pumps and stirring tanks can, therefore, impact the flocculant you choose.

## **Application**

Flocculant selection for different wastewater types is a complex challenge, with variable concentrations of substances like TSS, phosphorous and nitrogen creating daily uncertainty. This can be particularly tricky for businesses such as meat processors, who must adapt their flocculation chemistry depending on the composition of their effluent.

## **Safety**

In industrial processes, every human interaction with chemicals imposes risks. For this reason, flocculants that allow the process to be fully automated are favourable. The ease of cleaning up hazardous spills is also a critical factor when selecting the right flocculant.

## **Sustainability**

The treatment of water brings with it impacts on the environment. The reduction of these impacts is of increased concern for regulators and water treatment operators. The choices of flocculants used can make an impact here with some options requiring lower volumes of chemical use, reduced energy consumption and lower biological impacts. In some cases customers are setting requirements on the environmental profiles of such water treatment chemicals.

## **Cost**

Companies often only see and evaluate the initial cost of purchase. However, this is not always the whole picture. The total cost of the wastewater purification process consists of many aspects such as energy, clean water spend, sludge disposal cost, environmental permit costs, chemical spend, labour costs, equipment, and more.



## Three classes of flocculants

There are hundreds of different flocculants available in the market. They are predominantly based on polyacrylamide and possess a range of charge types, charge densities, molecular weights, and molecular structures. Each class has a range of qualities, and their pros and cons must be carefully weighed against the specific application, desired outcome, cost, and safety implications.

The three key classes of flocculants within the water treatment industry are powder flocculants, emulsions, and water-based dispersion flocculants. Combined, powder and emulsion flocculants probably comprise around 98% of the market. However, the recent innovation of water-based dispersion polymers is proving to be an exciting alternative to these more traditional flocculant formats.

# Powder (or granular) Flocculants

---

## Ease of Use



---

## Application



---

## Safety



---

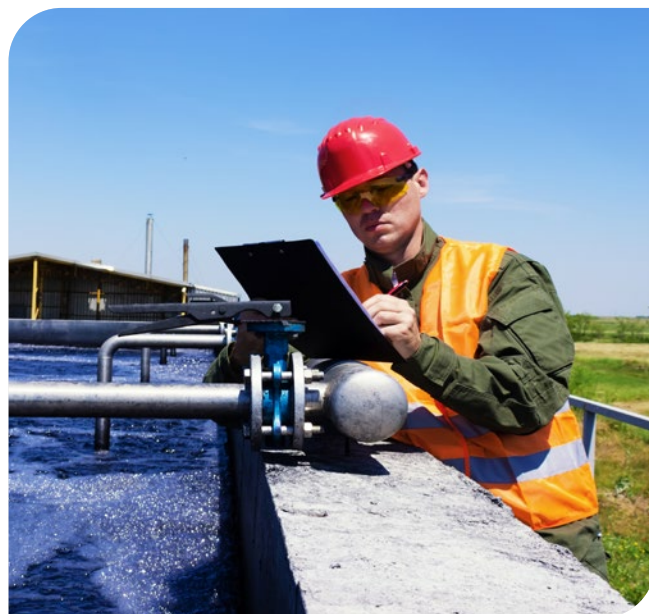
## Sustainability



---

## Cost

---



### Ease of Use

Powder flocculants must be dissolved in water before use. The user is unlikely to achieve 100% dissolution throughout this process. This means that the benefit of a high percentage of active content needs to be offset against the loss of flocculant through incomplete dissolving. Another important aspect is the maturation of the polymer, where large 'folded' polymer molecules unfold into straight lines to allow maximum surface interactivity with wastewater pollution to bind efficiently. This process is the slowest for powders, potentially taking one to several hours.

### Application

Powder flocculants may also not be the best option for applications requiring a highly structured polymer. This is because powders cannot be adequately branched or crosslinked, as it would make them insoluble. For specific applications, notably sludge dewatering, powders are inappropriate. This application needs highly structured polymers to create a floc strong enough to survive the sheer force of machines such as centrifuges, belt presses or screw presses.

### Safety

Powder flocculants present a specific spill hazard. They contain pure polyacrylamide, salts, and water. The fine particles in the powder are transparent and hard to spot when on the floor, meaning cleaning the spill away is challenging, and a residue can be left long after the initial spill.

### Sustainability

Calculating and comparing the ecological footprint of flocculants isn't easy. However, powder flocculants are produced in a liquid form and then dried. The drying process consumes a large amount of energy. Furthermore, due to the stirring required, the dissolving of the powder uses considerable energy and can take several hours to complete. It also requires large amounts of pure water to reconstitute it back to a liquid form. This makes powder formats more time-consuming, less efficient, and with a higher carbon footprint to manufacture and reconstitute than the alternative. However, they are highly concentrated and require lower transport emissions, giving them a transportation and logistics advantage over other flocculant formats.

### Cost

Powder/granular flocculants are, at face value, the most cost-effective flocculants on the market due to their high active percentage (around 90 – 95%). As a proven and well-established technology, they are the ideal solution for flocculation requirements if upfront cost sensitivity is your primary concern. They are highly concentrated and easy to transport, meaning in-use and transportation costs are lower than alternatives. However, the CAPEX investment for a powder preparation unit is generally high and should be considered for new installations.

# Emulsion Flocculants

## Ease of Use



## Application



## Safety



## Sustainability



## Cost



### Ease of Use

They are considered easier to use than powder flocculants because their emulsion format makes them easier to dose through simple pumps. Unlike powders, emulsions require less dissolving time and less energy to obtain a dissolved product.

### Application

Unlike powder flocculants, emulsions can be structured and crosslinked, making them more suitable for applications such as sludge dewatering, where they are the predominant type of flocculant used in the industry today since they were the first crosslinked option available. A potential drawback of emulsion flocculants is that they may create foaming issues in your system due to the presence of surfactants needed to keep the emulsion stable.

### Safety

Emulsion contains VOCs, surfactants and mineral oils, which are potentially harmful chemicals and thus need to be considered when interacting with emulsion polymers.

### Sustainability

The critical disadvantage of emulsion flocculants is their sustainability profile. Emulsions comprise approximately 50% active flocculant and 50% other chemicals such as mineral oil, surfactants, and solvents. These additional chemicals can be viewed

as pollutants in themselves. Although flocculant dosage is usually extremely low, it may prove problematic for those industries flocculating lots of water. For example, the dosage can range from 10 (part per million) to a few hundred (part per million). Despite the low dosage relative to the amount of water, we must still consider the potential impact of adding any amount of solvents and surfactants to wastewater.

Another environmental concern of emulsion flocculants is that the sludge created cannot be reused in a circular green economy. The sludge produced with powder flocculants and water-based dispersion polymers can be reused as feedstock for anaerobic biogas digesters. These digesters usually upgrade the digest into agricultural fertiliser. The presence of any mineral oils from the emulsion prohibits this from. For this reason, emulsion flocculants cannot be integrated into a circular economy, thus affecting their sustainability profile.

### Cost

Emulsion flocculants are often less cost-effective than powder flocculants due to their 50% active content whilst not enjoying other benefits to counteract the cost.

# Water-based dispersion Flocculants

<b>Ease of Use</b>	★★★★★
<b>Application</b>	★★★★☆
<b>Safety</b>	★★★☆☆
<b>Sustainability</b>	★★★★☆
<b>Cost</b>	★★★☆☆



Water-based dispersions are a relatively recent discovery within the wastewater treatment sector.

## Ease of Use

Water-based flocculants are extremely easy to use because they are already water-based. This means they have a relatively low viscosity, spillages are easily cleaned up, and the dissolution and maturation times are very short. These products are also the only format that can be dosed directly with an inline static mixer, as the turbulence of high flow rates is already enough to dissolve them in less than one minute properly.

## Application

Like emulsion flocculants, water-based dispersions can be structured, meaning they are highly versatile across a range of applications. The product comes as a water-based dispersion, where salt (no chlorides) protects the active flocculant content. This makes water-based flocculants the preferred choice in high-conductivity water, which is usually a challenge for conventional technologies like powders and emulsions. A typical market that faces this challenge is the production and treatment of metals.

By stabilising with salts, water-based flocculants have a lower final viscosity than powders and emulsions. This enables the flocculant to mix better with the particles and pollutants in the wastewater, making them preferable in highly

viscous waters and sludges such as biogas plants and the food industry. Across these industries, the dispersion protected by salt demonstrates a higher performance efficacy.

## Safety

Water-based flocculants are classified as non-hazardous, and due to their water based nature they are easy to clean up. They are undoubtedly the safest flocculant on the market today.

## Sustainability

Water-based dispersion polymers are produced with a lower carbon footprint than emulsions, an easily comparable rival as they are both liquid formats. These water-based alternatives can be produced with a smaller embedded carbon footprint when compared to emulsions.

## Cost

The primary disadvantage of water-based flocculants is that they are the most diluted product and have the lowest active flocculant content. For example, the typical water-based dispersion comprises around 50% water, 25% salts, and 25% active substances. This means that its higher dosage must offset the lower cost in €/kg. This dosage, however, is impossible to calculate; the only proper way to determine dosage is through lab or industrial tests, with the latter being preferred as ease-of-use arguments often leads to a much more efficient use of active substance.





## Conclusion

Emulsions, powders, and water-based dispersion polymers will all keep playing a role in the industry, but it is undeniable that the relatively unknown water-based dispersion polymers hold a lot of advantages over the more conventional products. The main aspects for all technologies are summarised within the framework below

[Click here](#)



Contact us at  
[watertreatment@univarsolutions.com](mailto:watertreatment@univarsolutions.com)  
or visit [univarsolutions.com](https://www.univarsolutions.com)

© 2023 Univar Solutions Inc. All rights reserved. Univar, the collaboration insignia, and other identified trademarks are the property of Univar Solutions Inc. or affiliated companies. All other trademarks not owned by Univar Solutions Inc. or affiliated companies that appear in this material are the property of their respective owners. The information contained herein cannot be changed without notice and you should contact the distributor to confirm. Read and follow the Product Label & Safety Data Sheet (SDS) for your health. All information is based on data obtained from the manufacturer or other recognized technical sources. Univar Solutions Inc. and its affiliates ("Univar") provides this information "as is" and makes no representation or warranty, express, or implied, concerning the accuracy or sufficiency of the information and disclaims all implied warranties. Univar is not liable for any damages resulting from the use or non-use of the information and each Univar affiliate is responsible for its own actions. The Customer is responsible for determining whether products and the information in this document are appropriate for Customer's use and for the adherence to the legal and regulatory environment and constraints within which the Customer operates in. Any information provided by Univar cannot be construed as a permission to use any product or process in breach of existing patents. All transactions involving this Product(s) are subject to Univar's standard Terms and Conditions, available at [www.univarsolutions.com](https://www.univarsolutions.com) or upon request. 144267 - Q1 2023