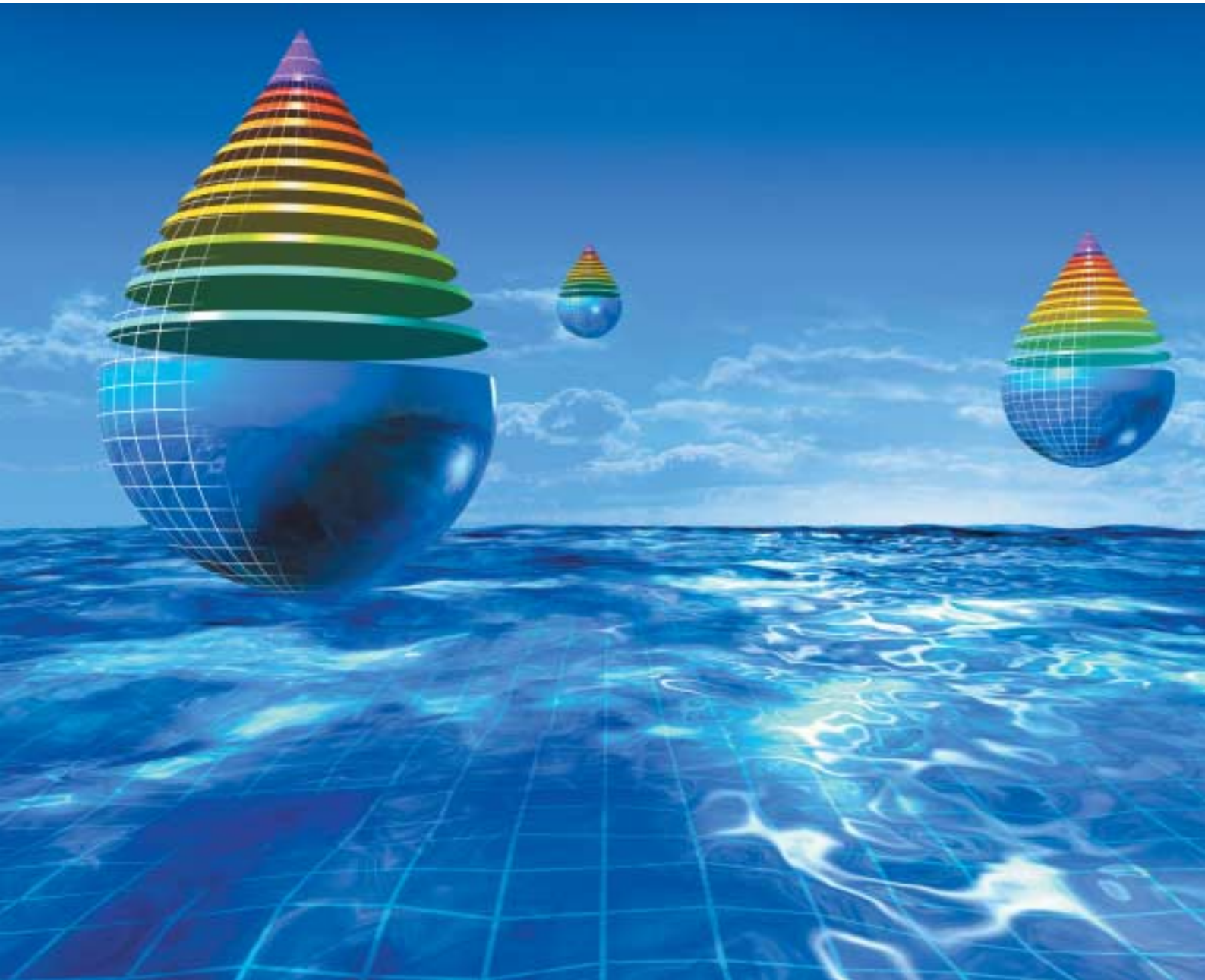


Performance Chemicals

Adding value to Flocculants



Sedipur[®] types for water treatment

**TENSID
CHEMIE**

BASF Group

Specialty chemicals for water treatment

Flocculants

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1. Introduction

Water is a vitally important commodity. Apart from domestic consumption for drinking and washing, there is hardly a branch of industry which does not use water for cooling, heating or steam generation. Water is the medium in which the vast majority of natural, biological reactions and chemical reactions take place.



At first glance, it would appear that water is available in inexhaustible quantities, but it soon becomes apparent on closer examination that natural water resources are limited because of intensive consumption. The answer to this problem is to reduce water consumption, to use water more efficiently, and to treat and recycle the water used in industrial processes.

BASF Aktiengesellschaft supplies high-quality products for use in all the most important water treatment processes, from purification through to process water treatment and effluent treatment. Depending on the problem to be solved, they can be used alone or as ingredients of special formulations.

2. The Sedipur range

Chemicals can be used to enhance the effectiveness of many different processes for separating solids from an aqueous liquid phase. Substances such as lime and clay have been used for centuries in water treatment processes, and starch and glue have been employed in industrial water treatment over the past hundred years. Polyelectrolytes are ionic, water-soluble polymers that were first introduced in the mining industry in the nineteen fifties, and they perform very effectively in a variety of applications.

Very finely divided solid particles often have to be removed from water, and the processes employed for this task have to be as economical as possible. The solids contents of these suspensions can vary within very wide limits, and their pH can range from acid to alkaline. These suspensions are encountered in many industrial processes and in municipal water treatment plants and sewage treatment plants. Many different problems need to be addressed, and flocculants often have to be tailored to specific requirements in order to make these treatment processes economically viable.

The most common applications for flocculants are

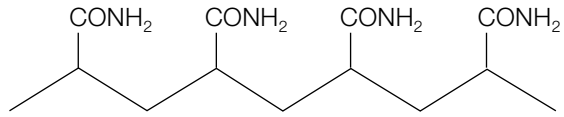
- Clarifying water
- Thickening suspensions, and
- Dewatering sludge

in industrial and municipal water treatment plants, effluent treatment plants and sewage treatment plants.

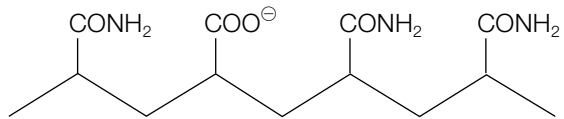
2.1 Chemical structure and mode of action

Usually, the only economical means of separating finely divided solid particles from water is to cause them to agglomerate. This causes them to increase in size, which enables them to form flocs which can be removed more quickly and easily. The BASF Sedipur range of flocculants contains products based on polyacrylamide, copolymers of acrylamide, acrylic acid and acrylic esters, and polyethylenimine. The range contains anionic, cationic and nonionic flocculants.

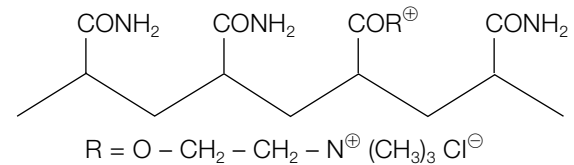
Polyacrylamide, nonionic



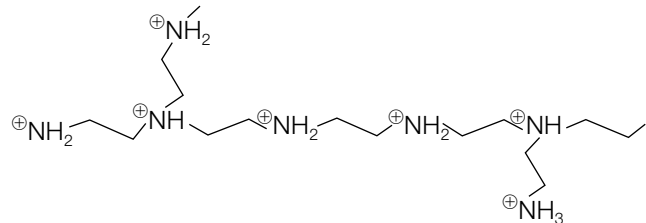
Substituted polyacrylamide, anionic



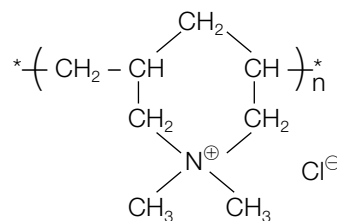
Substituted polyacrylamide, cationic



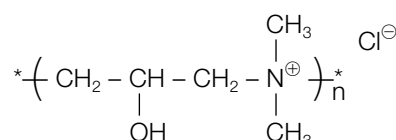
Polyethylenimine



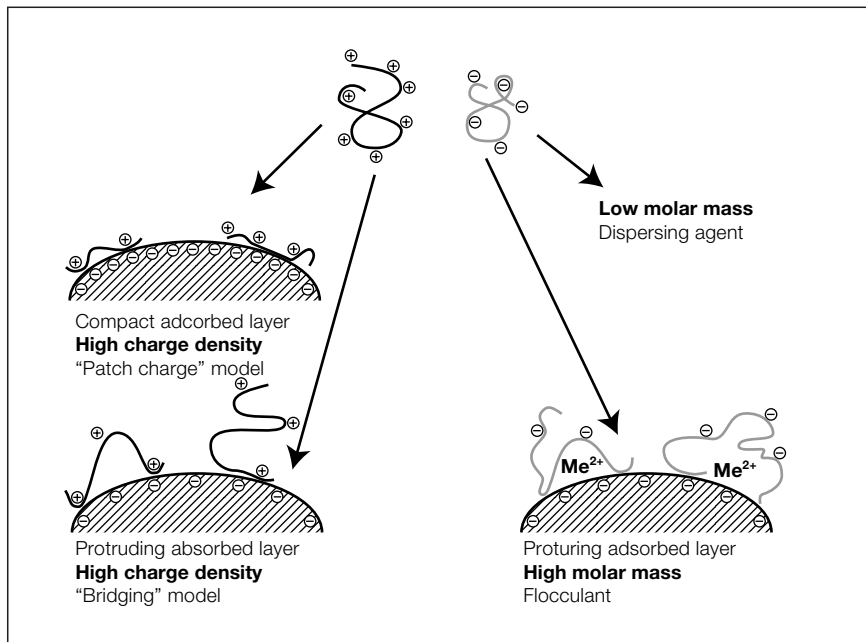
Poly-DADMAC



Polyamine



Anionic and cationic flocculants differ from each other in terms of their charge density. The mechanisms by which polymeric flocculants act are illustrated schematically in the diagram below.



The molar mass and charge density of polyelectrolytes such as the Sedipur types are the properties which have the greatest influence on their performance. The surfaces of particles suspended in water are predominantly negatively charged in the neutral to slightly alkaline or slightly acid pH range. The first step is therefore to partially neutralize the negative charge of these particles in order to cause them to flocculate. This can be achieved by causing cationic polyelectrolyte chains to adsorb on the surface of the particle, or by attaching anionic polyelectrolyte chains with the aid of metal ions. The latter are already present in hard water.

Nonionic flocculants attach themselves to suspended solids by means of hydrogen bonds. Generally speaking, the polymer chains do not form a flat, compact layer on the surface of the solid particles. They are only attached to the particles at a limited number of sites, and so the rest of the polymer chain protrudes into the surrounding space in the form of loops and threads. These act as tentacles, forming bridges with other particles, and this leads to the formation of larger agglomerates and eventually to flocs. This is referred to as the "bridging" model.

The bridging model is valid for most anionic and nonionic flocculants, and for cationic flocculants with a high molar mass. Polycations such as polyethylenimine or polyamine, which have a high charge density and a relatively low molar mass, tend to form a mosaic of flat, compact, localized patches when they adsorb onto the surface of suspended particles, and positively and negatively charged patches are present side by side. These charges are neutralised when particles coalesce to form a floc. This is referred to as the "patch charge" model.

2.2 Chemical nature

Sedipur A types

Anionic, substituted polyacrylamides with molar masses ranging from low to very high.

Sedipur N types

Nonionic polyacrylamides with a medium or high molar mass.

Sedipur C types

Cationic, substituted polyacrylamides, polyethylenimines, polyamines and poly-DADMAC with molar masses ranging from very low to very high.

Physical form

The Sedipur AF, NF and CF types are supplied in the form of fine, free-flowing, low-dusting, white powders.

Most of the Sedipur AL, NL and CL types are supplied in the form of milky white emulsions, but some are supplied as aqueous solutions.

2.3 Quality control

The most important features of flocculants from the point of view of their performance are the molar mass, the polarity of the ionic charge and the charge density. Our products are constantly subjected to quality control tests within the framework of our quality management programme.

2.4 Product range

Our range of Sedipur types is very extensive and varied, and we are constantly adapting our product range in order to fulfil the changing demands of the market. We have therefore decided to publish a separate brochure each year with information on our most up-to-date products. Information on our current product range is available on the internet at **www.tensid.de**

3. Applications

3.1 General

The Sedipur types are used to clarify, thicken and dewater suspensions.

Clarification

The Sedipur types enable suspended solids to be separated very effectively from water and aqueous solutions.

- Waste water
- Process water
- Continuous circuits
- Potable water



Thickening

They bring about a large increase in the solids content of sludge.

- Untreated sludge
- Hydroxide sludge



Dewatering

High solids content combined with a short retention time in filters, centrifuges and presses.

- Dredger sludge
- Activated sludge
- Oily sludge
- Gypsum plaster
- Pulp and other fibrous sludge



The Sedipur types can be employed in water and in aqueous solutions of organic and inorganic substances, but they cannot be used to flocculate solids suspended in organic solvents alone.

They cause solid particles to coalesce to form large, stable flocs. This increases the rate of sedimentation, and makes it possible for sludge to be dewatered.

This has a number of advantages.

- Higher loading rates are possible.
- Sludge and thickened sludge cakes have higher solids contents.
- Filtrates and treated effluent are clear and free of solids.

Each of the Sedipur types has its own specific areas of application, and levels of addition vary from product to product. The composition of the effluent or sludge to be treated, the type of process and the equipment that is employed all have to be taken into account.

The high-molar-mass Sedipur types are mainly employed in sedimentation processes and dewatering processes in which the flocs have to be very stable. The Sedipur types with a medium molar mass are more appropriate for filtration processes. It is important to carry out trials in the laboratory to determine the most appropriate product before flocculants are adopted in new processes or if operating conditions change.

Our technical staff are always pleased to give advice.

The Sedipur types have to be diluted with water before use, and there different techniques have to be employed for diluting solid and liquid products (See Section 3.5).

3.2 Sedipur A and Sedipur N types

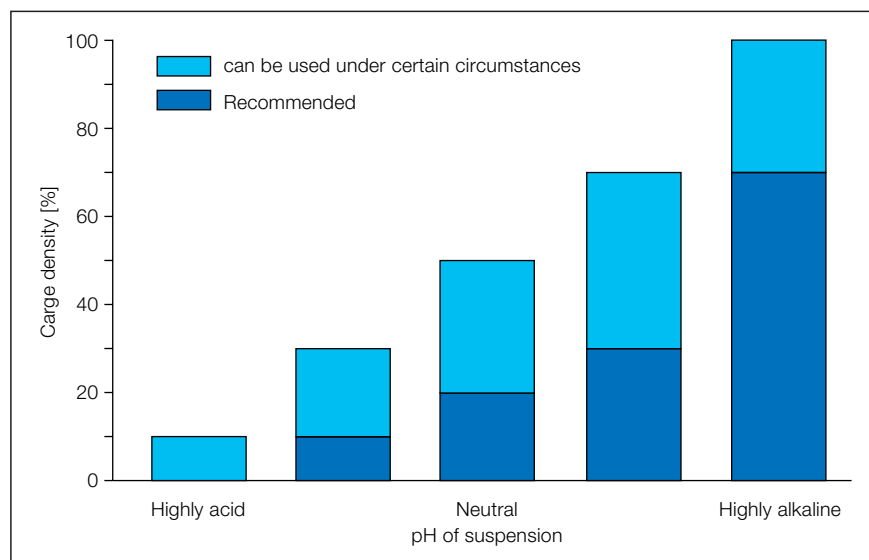
The Sedipur A and Sedipur N types are most effective for flocculating suspensions and sludges of a predominantly inorganic nature.

The Sedipur A types perform well in the slightly acid to strongly alkaline pH range. The Sedipur N types are recommended for strongly acidic suspensions.

Sedipur A and Sedipur N for flocculating inorganic solids

Low pH → Low charge density

High pH → High charge density



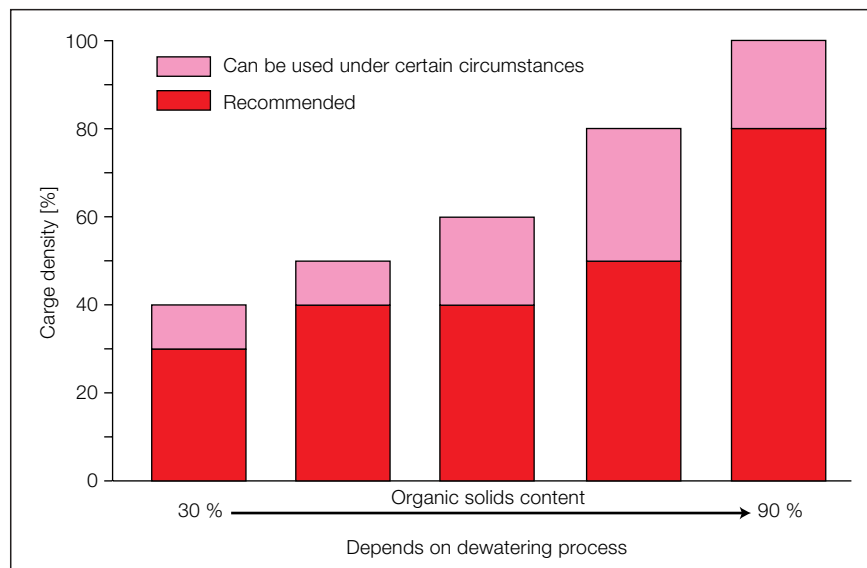
3.3 Sedipur C types

The Sedipur C types are cationic, which means that they are most appropriate for treating effluent and sludge that contains solids of a predominantly organic nature. An important area of application for the Sedipur C types is in municipal sewage treatment plants and in industrial effluent treatment.

Sedipur A and Sedipur N for sewage treatment

Low proportion of organic solids → Low charge density

High proportion of organic solids → High charge density



3.4 Combinations of Sedipur A and Sedipur C types

It can be useful to combine Sedipur A and Sedipur C types in some processes. This makes it possible to take advantage of the synergistic interaction between anionic and cationic flocculants. This method can sometimes be the only economical means of obtaining reliable results.

3.5 Dissolving Sedipur types

Various automatic and semi-automatic systems are available on the market for dissolving and metering flocculants. Our technical staff are always pleased to advise on the capacity and level of automation of metering equipment.

Dissolving powders

Laboratory

Fill a 250 ml conical flask with 100 ml of potable water and place it on a magnetic stirrer. Accurately weigh out a 0.5 g sample of Sedipur and slowly sprinkle it into the water, stirring vigorously.

The water in the flask should be discarded if the powder is sprinkled in too quickly and lumps form, because these take much too long to dissolve. It is usually sufficient to stir the solution for one hour to ensure that the powder is properly dissolved. The solution can then be diluted down to the concentration at which it is to be applied.

Cationic stock solutions such as these, with a concentration of 0.5 %, should not be kept in storage for any longer than a week.

Dilute solutions can be prepared from stock solutions daily as required.

Full-scale practice

Add the Sedipur to the water while it is being stirred, and use an eductor or a similar device to wet the powder in advance in order to prevent lumps from forming.

Once the Sedipur has been added and the tank has been filled with water, the solution has to be stirred for another 30–60 minutes before it is fully dissolved and ready for use. Heating has no influence on the time Sedipur takes to dissolve at temperatures between 5 °C and 20 °C.

The final concentration of the Sedipur solution should be in the 0.03–0.3 % range, but no higher. A 0.5 % stock solution should be made up and watered down prior to being metered if the capacity of the holding tank is insufficient for one day's supply.

Diluting emulsions

The concentration of the polymer dissolved in the finely divided aqueous phase of emulsions is too high for products of this type to be used undiluted.

Emulsions of this type can gradually demix during storage. They have to be stirred or circulated before they are taken out of the holding tank.

Laboratory

Fill a 600 ml beaker with 200 ml of potable water, and stir it with a laboratory stirrer at 500 rpm.

Briefly homogenize the flocculant by shaking. Prepare a solution with a polymer content of 0.5 % by adding the emulsion to the water with a calibrated pipette. The solution is ready for use after it has been stirred for 15 minutes (Sedipur CL) or 30 minutes (Sedipur AL and NL). It can then be diluted down to the desired concentration.

Distilled water or deionized water should be used rather than potable water for anionic Sedipur types with a high charge density.

Full-scale practice

Manual dilution

Fill the tank with water so that the stirrer head is just immersed in the liquid, and switch the stirrer on. Pour a thin stream of emulsion into the eddy. The polymer content of the concentrated emulsion has to be taken into account.

Then make the concentrated solution up to the mark with water. The dilute solution is ready to use after it has been stirred for a further 15 to 30 minutes. Its active content should be in the 0.03 %– 0.3 % range. At higher concentrations, solutions are too viscous for them to mix homogeneously with the sludge, and this will result in increased consumption.

Solutions

A few of the Sedipur types are supplied in the form of concentrated aqueous solutions. They are comparatively easy to dilute. Solutions can simply be mixed with water in a mixer and metered direct into the slurry.

3.6 Laboratory tests

It is advisable to test products in the laboratory before trying them out in full-scale plant. A number of different test methods are available, depending on the application in question.

Test	Area of application
Sedimentation tests in glass tubes	Clarifying suspensions with high solids contents
Sedimentation tests in glass jars, stirred in series	Clarifying suspensions with low solids contents
Sedimentation tests in measuring cylinders/glass jars	Dewatering sludge
Filtration:	
– By gravity	Gravity filters
– Under pressure	Filter presses, belt-press filters
– Under vacuum	Vacuum filters
Centrifugation	Dewatering sludge by high-performance centrifugation
CST Test	Dewatering behaviour of flocculated sludge subjected to increasing mechanical action

Note Tests in the laboratory can only confirm whether or not a particular product is effective in a given application. The levels of addition required in practice can only be determined in full-scale trials, and depends on the process involved, the equipment employed and the throughput of solids. The flocculant must be selected so as not to impair subsequent processing.

3.7 Processing waste activated sludge

Clarification

The aim here is to obtain as clear an overflow as possible.

The Sedipur types are strongly flocculant, and small amounts provide a large increase in the sedimentation rate.

Clarification is a steady-state process. The volumetric flow rate, solids content and sedimentation rate on the input and output sides of the equation must be in equilibrium to ensure smooth running.

Volumetric flow rate

$$Q = Q_1 + Q_2$$

where

Q = Volumetric flow rate of influent

Q₁ = Volumetric flow rate of overflow

Q₂ = Volumetric flow rate of underflow

Solids content

$$(Q \times C) = (Q_1 \times C_1) + (Q_2 \times C_2)$$

where

C = Solids content of influent

C₁ = Solids content of overflow

C₂ = Solids content of underflow

Sedimentation rate

$$v_{th} = \frac{Q_1}{A \times \eta_{Eff}}$$

where

η_{Eff} = Effective surface overflow rate

V_{th} = Theoretical sedimentation rate in m/h

A = Surface area in m²

Theoretical surface overflow rate

$$K_{th} = \frac{Q_1}{A}$$

where

K_{Th} = Theoretical surface overflow rate

Effective surface overflow rate

$$K_{\text{Eff}} = \frac{Q_1}{A \times \eta_{\text{Eff}}}$$

where η is dependent on

- a) the area unavailable owing to turbulence at the inlet and outlet
- b) the area unavailable around the sides of rectangular tanks, etc.

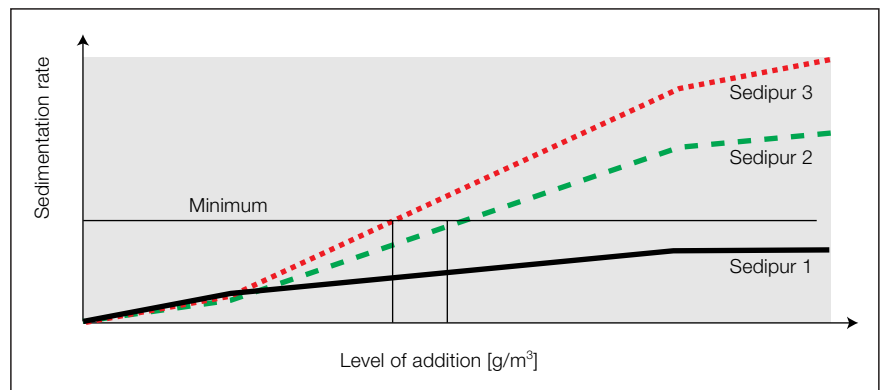
Minimum sedimentation rate
where $C_1 = 0$

$$v_{\text{min}} = \frac{Q_1}{A \times \eta_{\text{Eff}}}$$

If the required rate of sedimentation is calculated for the particular clarifier in question, the rate at which the suspended solids precipitate can be determined in laboratory tests.

This allows a sedimentation curve showing the minimum flocculant concentration to be plotted.

Sedimentation curve



The Sedipur types usually need to be added at rates of between 0.2 g/m³ and 5 g/m³ of suspension.

Thickening

The Sedipur types can also be used to thicken sludge by sedimentation and flotation.

Polymers do not have any influence on the extent to which slurries can be thickened, but they do provide a considerable increase in the rate of sedimentation.

In flotation processes, polymers cause flocs to rise to the surface more quickly, especially if they naturally float. This improves the flocculation efficiency and the clarity of effluents.

Generally speaking, 5–20 g of Sedipur per cubic metre of suspension is required, but 1 g per cubic metre of waste sludge is usually sufficient in settling tanks.

It has been shown that Sedipur does not interfere with biotic processes when thickened sludge is treated by anaerobic digestion (H. Kapp, *Institut für Siedlungswasserbau, Wassergüte und Abfallwirtschaft*, University of Stuttgart; *gwf-Wasser/Abwasser* **126**, H2, 76, 1985).

Dewatering

The products in our Sedipur range are designed for use in centrifuges, filter presses, vacuum filters and all other conventional equipment.

Centrifugation

Floccules are exposed to high levels of shear in centrifuges, and so they have to be made as stable as possible.

The high-molar-mass Sedipur types perform best in centrifuges. The best place to add Sedipur solutions is either just upstream of the centrifuge or in the centrifuge itself, but this has to be determined empirically when the centrifuge is being run in. Sludge suspensions should preferably not be pumped after the flocculant has been added, to ensure that the floccules are not broken down by shear.

The amount of Sedipur required depends on the nature of the sludge, its solids content, the type of centrifuge employed, and the desired solids content of the sludge cake. Between 50 g and 200 g of Sedipur per cubic metre of sludge is usually required, and this is normally sufficient to yield a clear effluent and sludge cakes with solids contents of greater than 99%.

Belt-press filters

It is important that the sludge is adequately flocculated before it is loaded onto the belt. It is important that the water is able to drain through the belt before the sludge is pressed, and that the presscake can easily be removed after pressing. Presscakes obtained by this method have high solids contents.

Between 50 g and 200 g of Sedipur per cubic metre of sludge is required.

Experience has shown that the Sedipur types with a medium molar mass often perform best, because they can have a significant effect on the rate at which the sludge dewateres on the belt.

Filter presses

Like centrifuges and belt-press filters, plate-and-frame filter presses also depend on the sludge having formed stable flocs before it is filtered. Care must be taken not to disrupt these large floc particles when filling filter presses. A number of methods are available which offer technically acceptable, economically viable solutions to this problem, such as metering in the flocculant at the suction and discharge ports of pumps, or gradually increasing the pressure in the press in several stages.

Vacuum filtration

Most of the Sedipur types used to boost the performance of vacuum filters have a medium molar mass.

Static mixers can be useful for promoting intermixing between the sludge and the flocculant. The flocculant should be added to the stream ahead of the static mixer by means of metering pumps, which ought preferably to be protected with a filter.

The amount of flocculant required per tonne of dry solids depends on the particle structure of the slurry and the degree of dewatering desired, and it can fluctuate considerably. Between 5 g and 180 g of Sedipur per tonne of dry solids can be required.

3.8 Areas of application

Coal mining

Anthracite

Clarifying wash water
Clarifying flotation tailings

Dewatering sludge and flotation concentrates in drum, disc and vacuum belt filters

Dewatering flotation tailings in solid-bowl centrifuges and belt-press filters

Lignite

Clarifying pit water

Ore production and smelting

Lead and zinc mining

Dewatering flotation tailings
Thickening concentrates
Boosting performance of concentrate filters

Iron ore

Water treatment

Iron smelting

Treating water used for scrubbing blast furnace gas
Treating water left over from sintering
Treating effluents from pickling
Wet dedusting plants in foundries

Copper mining

Clarifying flotation tailings
Thickening concentrates
Boosting performance of concentrate filters

Potash and salt

Potash

Clarifying hot solution
Clarifying circulated solution
Dewatering sludge

Salt

Clarifying crude brine
Dewatering sludge

Other applications in mining and quarrying

Phosphates

Clarifying wash water
Filtering gypsum

China clay

Clarifying china clay suspensions

Quartz sand

Clarifying wash water

Barytes and fluorspar

Clarifying flotation tailings

Gravel, porphyry and limestone quarries

Treating wash water

Bauxite refining

Thickening red muds in the Bayer alumina process

Miscellaneous industries

Oil refining

Water treatment (decarbonizing)
Effluent treatment by sedimentation or flotation
Dewatering sludge

Tanneries

Electroplating

Ceramics

Automobile industry

Water treatment

Sugar refining

Clarifying sugar juice

Dewatering sludge

Treating water used for washing sugar beet

Drinking water

Water treatment

Conditioning filters

Clarifying water used to flush filters

Dewatering hydroxide sludge

Power generation

Water treatment

Filter conditioning

Waste treatment

Municipal sewage treatment plants

Clarification

Thickening

Dewatering

Soil reclamation, drilling mud

Clarification

Thickening

Dewatering

Silt and sand from dredging

Clarification

Thickening

Dewatering

3.9 Practical examples

Water treatment

Water has to be treated before it can be used as drinking water or process water because of the organic and inorganic impurities it contains. The process by which it is treated depends on the total level of contaminants it contains and the desired water quality.

The suspended solids contained in highly contaminated water generally need to be flocculated in advance with trivalent iron or aluminium salts. These salts are hydrolyzed in water. The colloidal impurities that are responsible for the turbidity, colour and odour of the untreated water are able to adsorb on these insoluble hydroxides.

Between 0.05 g/m³ and 0.5 g/m³ of Sedipur AF 402 or Sedipur AF 403 can then be added in order to increase the rate at which the hydroxide flocs form a sediment. A large increase in the rate of sedimentation can be achieved. This treatment plant can either be run at a higher loading rate, or the load at the subsequent filtration stage can be reduced.

Drinking water

Only products that conform to DIN EN 1407 may be used for drinking water. They have to have a residual acrylamide monomer content of less than 0.025 %, and this limit is monitored on a continuous basis.

The Sedipur types can be used for the following purposes in the purification of drinking water.

- Increasing the rate at which iron hydroxide and aluminium hydroxide flocs form a sediment in the preliminary treatment
- Conditioning filters
- Treating the filter backflush water
- Dewatering hydroxide sludge on gravel beds or in centrifuges

Treating process water

Water quality is of crucial importance for trouble-free operation in many industrial cooling and heating processes.

Industrial process water is treated in the same manner as described above.

In the past, calls have increasingly been made to replace inorganic flocculants with synthetic, organic products.

Oil production

The water used in enhanced oil recovery is treated as follows.

- Pretreatment and flocculation by sedimentation
- Filtration through gravel
- Softening (ion exchange)

The aluminium sulphate used for flocculation can be replaced with Sedipur CL 910, an organic primary flocculant. Sedipur CL 910 needs to be added at a rate of 140 ppm (concentration as supplied).

Sedipur CL 910 has the following advantages over aluminium sulphate.

- Sedipur CL 910 is supplied in the form of a 10 % solution which can be metered direct from the drum.
- It does not cause any increase in the sulphate content of the treated water.
- The efficiency of sedimentation and gravel filtration processes is better, because resin flocs have a higher density than hydroxide flocs.
- The solids content of the treated water is lower owing to the much higher efficiency of Sedipur CL 910.
- The gravel filter has a longer working life, and there is less contamination of the ion exchanger with suspended particles.

Refinery effluent

Refinery effluent often has a residual oil content of up to 1000 ppm after the supernatant oil has been skimmed off mechanically. The remaining oil can be removed during flotation and other subsequent processes with a mixture of primary flocculants and anionic flocculants.

In view of the fact that oily sludge is often disposed of by incineration, it can be advisable to use organic primary flocculants such as Sedipur CL 910 instead of iron or aluminium salts, or to pretreat the effluent with cationic, low-molar-mass flocculants such as Sedipur CL 930.

Process	Effluent treatment	Result
Conventional	30 ppm Fe 2 ppm Sedipur	Reduction in residual oil content from 70–210 ppm to 7–11 ppm
Option I with cationic flocculants	5 ppm Fe 3–5 ppm Sedipur I 2 ppm Sedipur II	Reduction in residual oil content from 85–190 ppm to 6–9 ppm
Option II with primary flocculants	30 ppm Primary flocculant 2 ppm Sedipur	Reduction in residual oil content from 125–275 ppm to 6–8 ppm

The Sedipur A and Sedipur C types can boost the efficiency of centrifuges, belt-press filters and other equipment used to dewater oily sludge.

Metal industry

Large quantities of effluent containing suspended solids are generated in the following processes.

- Scrubbing blast furnace gas
- Wet dedusting
- Pickling
- Metal finishing

The effluent has to be pretreated in order to prevent suspended solids from forming scale in pipes and cooling towers, etc.

Treating the effluent with Sedipur after it has been neutralized, detoxified and clarified can enable it to be recycled.

This allows the fresh water consumption and the load on effluent treatment plants to be reduced. It can be advisable to use a combination of different types of flocculant in some cases.

A common advantage of treating effluent with Sedipur is that the sludge is easier to dewater later on.

Examples:

Blast furnace gas I

2000 m ³ /h	0.1 g/m ³ Sedipur A
Influent	320–370 mg solids/l
Effluent	12–16 mg solids/l

Blast furnace gas II

2000 m ³ /h	0.1 g/m ³ Sedipur C
Influent	0.1 g/m ³ Sedipur A
Effluent	320–370 mg solids/l
	12–16 mg solids/l

Effluent from pickling

40–50 m ³ /h	2–4 g/m ³ Sedipur A
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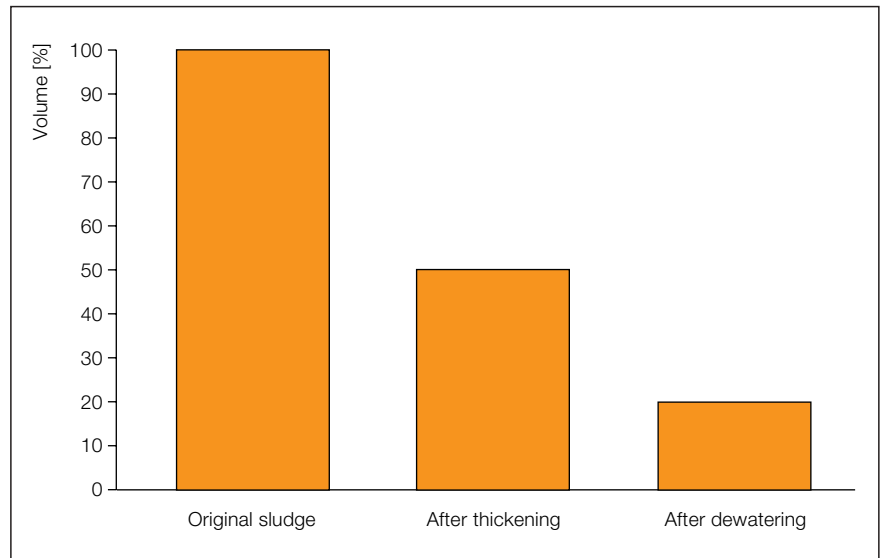
The solids content can be increased to > 30 g/l and the overflow, free of solids, can be recycled

Tunnelling, dredging, land reclamation

Large quantities of sludge of varying composition are generated by tunnelling operations, dredging and land reclamation. These sludges need to be spread over a large area in order for them to dry.

Practical experience has shown that the volume of sludge generated can be reduced substantially by thickening and dewatering.

Example – Reduction in sludge volume after thickening and dewatering



It is often sufficient to use one single Sedipur type for thickening and dewatering sludge, but combinations of different types of Sedipur have proved very successful, because this allows variations in the composition of the sludge to be accommodated.

Example 1: Drilling mud

Application	Products and rates of addition
Centrifuges	160 –180 g Sedipur A 250 g Sedipur C
Belt-press filters	160 –180 g Sedipur A 70 –100 g Sedipur C

Example 2: Dredger sludge

Application	Products and rates of addition
Thickening	5 –10 g Sedipur A or 5 g Sedipur A 10 – 20 g Sedipur C
Dewatering	200 g Sedipur A 100 – 300 g Sedipur C

Municipal sewage treatment plants

The use of flocculants for treating sewage and dewatering sludge has been stimulated by increasing volumes of sewage and the more stringent demands on effluent quality that have been generated by greater environmental awareness.

Our Sedipur types can be used at a number of stages in sewage treatment processes.

- Primary treatment
- Thickening sludge
- Dewatering sludge
- Treating sludge that contains phosphates
- Filtration

The following examples illustrate the variety of applications that exist for the Sedipur types, the various problems encountered in their use, and the benefits that they offer.

Applications	Problems	Advantages offered by flocculants
Primary treatment (Simultaneous sedimentation of phosphates)	Excessively high hydraulic loading rates, low compaction, removal of phosphates	Reduction in volume of primary sludge, reduced load on biological treatment stage
Thickening waste sludge <ul style="list-style-type: none"> • Static • Belt-press filters • Centrifugation • Flotation 	Low dry solids content Bulky sludge Short digestion time, low efficiency	Solids content can be increased by a factor of 5–10 Sludge is less bulky Less load on subsequent stages, lower recirculation rates
Thickening digested sludge	Low dry solids content Increased load at dewatering stage	Reduction in volume of digested sludge Reduced load at dewatering stage, higher efficiency, savings in flocculant consumption
Dewatering sludge	Disposal of sludge	Higher dry solids content, less bulky sludge, high concentration, no recirculation of solids
Post-treatment	Solids removal Problems with filters Problems meeting prescribed limits	Cleaner effluent, less load placed on filters, peaks can be accommodated if hydraulic loading rate is too high
Removing phosphates	Observing limits, thickening phosphate sludge	Less bulky sludge, effluent contains less solids

Thickening waste sludge

Existing facilities for thickening waste sludge are often overloaded.

This causes problems with increased solids recirculation and high volumes of sludge with a low solids content.

The Sedipur types can be used to boost the efficiency of thickeners, flotation cells and other equipment. The higher loading rates mean that less investment is required in equipment such as centrifuges and belt-press filters.

Examples:

Static thickening	1–2 kg/tonne dry solids	4–10-fold decrease in bulk at concentration rate of > 95 %
Centrifugation	1.5–2.5 kg/tonne dry solids	6–10-fold decrease in bulk at concentration rate of > 95 %
Belt-press filters	3–5 kg/tonne dry solids	6–10-fold decrease in bulk at concentration rate of > 95 %
Flotation	0.2–2 kg/tonne dry solids	4–10-fold decrease in bulk at concentration rate of > 95 %

Better thickening also leads to better dewatering and better results in processes such as anaerobic digestion.

Thickening digested sludge

It is often useful to thicken digested sludge if the dewatering stage is run at a high proportion of capacity, and this can also result in reduced Sedipur consumption.

Dewatering	With no static thickening	With static thickening
Example 1		
Volume	150–170 m ³	75–85 m ³
Dry solids content	2.5 %	5 %
Total flocculant consumption	7.2–8 kg/t dry solids	6–6.2 kg/t dry solids
Example 2		
Volume	300 m ³	150 m ³
Dry solids content	3 %	6 %
Total flocculant consumption	2.7–3 kg/t dry solids	2.2–2.4 kg/t dry solids

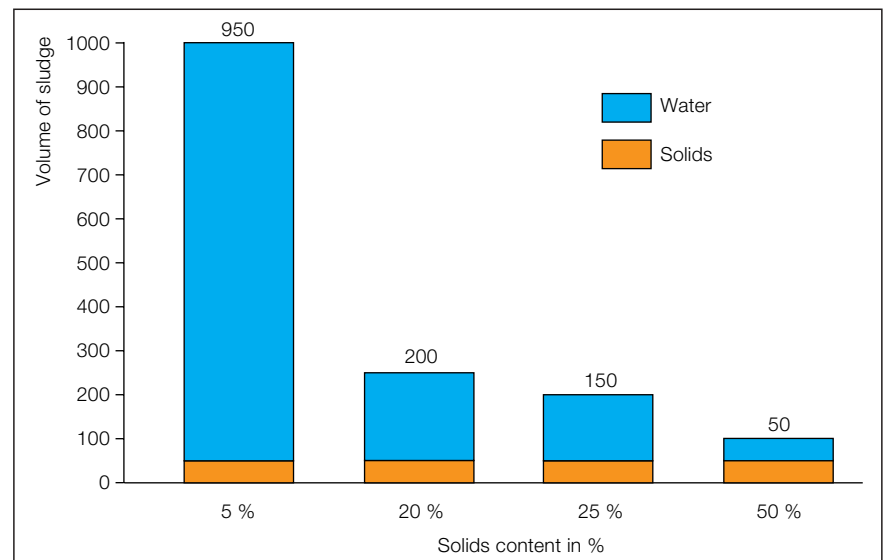
In both of the examples above, thickening the digested sludge had the following advantages.

- The dewatering equipment downstream was able to be operated more efficiently.
- Less working hours were required.
- Savings in energy were possible.
- The hydraulic load on the dewatering equipment was lower.

Dewatering sludge

Increasing volumes of sludge, restricted landfill capacity and more stringent regulations governing landfill sites and agricultural spreading, etc., underline the importance of being able to dewater sludge efficiently.

The following diagram shows the volume of sludge compared to its solids content.



The Sedipur types have been employed successfully in all dewatering processes.

Process	Rate of addition	Dry solids content after dewatering
Centrifugation	2–7 kg/t dry solids	20–34 %
Filter presses	4.5–5.4 kg/t dry solids	34–45 %
Belt-press filters	2–6 kg/t dry solids	20–35 %

Filtration and treatment downstream

The problem here is that excessive levels of finely suspended solids can find their way into receiving waters and filtration equipment downstream if the suspended solids content at the end of the treatment process is too high.

The Sedipur types can be used to promote the sedimentation of suspended solids

- Legal limits can be adhered to;
- The sludge volume index can be improved;
- Undesirable discharges of suspended solids can be avoided;
- Less of a load is placed on filtration equipment downstream.

Unlike iron salts, which form deposits in incineration plants, the Sedipur types do not have any adverse effects when the sludge is incinerated.

Sewage treatment plant

A	0.5–1 g/m ³	Reduction in suspended solids from 30–80 mg/l to < 20 mg/l, or from 120–140 mg/l to < 40 mg/l
B	0.5 g/m ³	Reduction in sludge volume index from 160 to 90, reduction in suspended solids
C	1 g/m ³	Reduction in sludge volume index

4. Safety

We know of no ill effects that could have resulted from using the Sedipur types for the purpose for which they are intended and from processing them in accordance with current practice.

According to the experience that we have gained over many years and other information at our disposal, the Sedipur types do not exert any harmful effects on health, provided that they are used properly, due attention is given to the precautions necessary for handling chemicals, and the information and advice given in our Safety Data Sheets are observed.

4.1 Handling

The usual precautions when handling chemicals must be observed. Safety glasses should be worn at all times, and a respirator should be worn when handling these products in large quantities.

Spills pose a hazard, because they are extremely slippery.

Damaged containers should be placed in a large sack to prevent the powder from spilling out. Damaged drums containing liquids should be emptied. Spills should be carefully scooped up, and the residue should be rinsed away with plenty of water. It is not enough simply to cover spills with sand, earth or sawdust.

4.2 Storage

The Sedipur types supplied in powder form should be stored in a dry place. It is important that containers are resealed immediately after material is taken from them. The products supplied in powder form have a shelf life of at least one year. The Sedipur types supplied in liquid form have a shelf life of at least six months.

The liquid Sedipur types solidify at temperatures below -8°C , but this does not affect their performance after they have been thawed.

5. Note

The information submitted in this publication is based on our current knowledge and experience. In view of the many factors that may affect processing and application, these data do not relieve processors of the responsibility of carrying out their own tests and experiments; neither do they imply any legally binding assurance of certain properties or of suitability for a specific purpose. It is the responsibility of those to whom we supply our products to ensure that any proprietary rights and existing laws and legislation are observed.

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Tensid-Chemie Vertriebsgesellschaft mbH
Maarweg 163
50825 Köln

Postanschrift:
Postfach 45 12 25
50887 Köln

Tel. 0221 95464-02
Fax 0221 95464-211
E-Mail: info@tensid.de
www.tensid.de



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