kuraray

kuraray poval
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- Technical data sheet -

®Kuraray Poval

Characteristics

Polyvinyl alcohol (PVA) grades with varying degrees of polymerization and hydrolysis.

Recommended Uses

Modification of emulsion adhesives, production of paper adhesives and remoistenable adhesives. Protective colloid in emulsion polymerization and raw material for the production of sizes and textile finishes. Binder in the surface finishing of paper. Also for regulating the processing characteristics of all types of coatings.

Delivery form

Granules, if not specified otherwise.

Data

The data are determined by our quality control for each lot prior to release.

	Kuraray Poval® New grade name	Old grade name	viscosity[1)] [mPa s]	degree of hydrolysis (saponification) [mol-%]	ash content[2)] max. [$^{w}/_{w}$ %]
Partially hydrolysed	KURARAY POVAL 3-88	PVA-203	3.2 – 3.6	87.0 – 89.0	0.4
	KURARAY POVAL 5-88	PVA-205	4.6 – 5.4	86.5 – 89.0	0.4
	KURARAY POVAL 5-88 S2[3)]	PVA-205S[3)]	4.6 – 5.4	86.5 – 89.0	0.4
	KURARAY POVAL 5-88 MB[3)]	PVA-205MB[3)]	4.6 – 5.4	86.5 – 89.0	0.4
	KURARAY POVAL 22-88	PVA-217	20.5 – 24.5	87.0 – 89.0	0.4
	KURARAY POVAL 22-88 S2[3)]	PVA-217S[3)]	20.5 – 24.5	87.0 – 89.0	0.4
	KURARAY POVAL 22-88 SB[3)]	PVA-217SB[3)]	20.5 – 24.5	87.0 – 89.0	0.4
	KURARAY POVAL 22-88 MB[3)]	PVA-217MB[3)]	20.5 – 24.5	87.0 – 89.0	0.4
	KURARAY POVAL 30-88	PVA-220	27.0 – 33.0	87.0 – 89.0	0.4
	KURARAY POVAL 30-88 S2	PVA-220S	27.0 – 33.0	87.0 – 89.0	0.4
	KURARAY POVAL 30-88 SB[3)]	PVA-220SB[3)]	27.0 – 33.0	87.0 – 89.0	0.4
	KURARAY POVAL 44-88	PVA-224	40.0 – 48.0	87.0 – 89.0	0.4
	KURARAY POVAL 44-88 S2[3)]	PVA-224S[3)]	40.0 – 48.0	87.0 – 89.0	0.4
	KURARAY POVAL 44-88 SB[3)]	PVA-224SB[3)]	40.0 – 48.0	87.0 – 89.0	0.4
	KURARAY POVAL 49-88	PVA-225	45.0 – 52.0	86.5 – 89.0	0.4
Medium hydrolysed	KURARAY POVAL 27-96	PVA-CST	24.0 – 30.0	95.5 – 96.5	0.4
	KURARAY POVAL 17-94	PVA-613	14.5 – 18.5	92.5 – 94.5	0.4
Fully hydrolysed	KURARAY POVAL 3-98	PVA-103	3.2 – 3.8	98.0 – 99.0	0.7
	KURARAY POVAL 5-98	PVA-105	5.2 – 6.0	98.0 – 99.0	0.7
	KURARAY POVAL 5-98 DB[3)]	PVA-105K[3)]	5.2 – 6.0	98.0 – 99.0	0.7
	KURARAY POVAL 11-98	PVA-110	10.2 – 11.8	98.0 – 99.0	0.7
	KURARAY POVAL 28-98	PVA-117	25.0 – 31.0	98.0 – 99.0	0.4
	KURARAY POVAL 28-98 DB[3)]	PVA-117K[3)]	25.0 – 31.0	98.0 – 99.0	0.4
	KURARAY POVAL 28-98 S2[3)]	PVA-117S[3)]	25.0 – 31.0	98.0 – 99.0	0.4
	KURARAY POVAL 60-98	PVA-124	54.0 – 66.0	98.0 – 99.0	0.4
High MW	KURARAY POVAL 100-88	PVA-236	90 – 110	87.0 – 89.0	0.4
Low hydrolysed	KURARAY POVAL 32-80	PVA-420H	29.0 – 35.0	79.0 – 81.0	0.4
	KURARAY POVAL 48-80	PVA-424H	45.0 – 51.0	78.5 – 80.5	0.2
	KURARAY POVAL 40-80 E	PVA-420	37.0 – 45.0	79.0 – 81.0	0.4
	KURARAY POVAL 3-80	PVA-403	2.8 – 3.3	78.5 – 81.5	0.4
	KURARAY POVAL 5-82	PVA-405	4.5 – 5.2	80.0 – 83.0	0.4
	KURARAY POVAL 5-74	PVA-505	4.2 – 5.0	72.5 – 74.5	0.4

[1)] *of a 4 % polymer solution at 20°C, determined by Brookfield synchronised-motor rotary-type viscometer (JIS K6726)*

[2)] *calculated as Na_2O*

[3)] *MB, SB, DB: anti-foaming/defoaming grade; S2: finer powder grade*

Additional data, valid for all Kurary Poval® grades

Volatile content max. 5% (based on measurement in packaging)

Methanol content: a general specification is less than 3 %.

pH of a 4 % solution in distilled water 4.5 – 7.

The viscosity of the 4 aqueous solution at 20°C is a relative measure for the molar mass of the PVA grade, the mentioned degree of hydrolysis of the polyvinyl acetate from which the PVA grade is derived. There is a subdivision into “partially hydrolysed”, “medium hydrolysed”, “fully hydrolysed”, “low hydrolysed”.

MB-, SB-, DB- grades are Poval types pre-treated with an anti-foaming agent.

S2-grades are finer powder grades (80-100 mesh pass).

Properties and uses

Polyvinyl alcohols are water-soluble polymers manufactured by alcoholysis of polyvinyl acetate.

The properties of the various grades are mainly governed by the molecular weight and the remaining content of acetyl groups.

Because polyvinyl alcohols have such good cohesion and good adhesion to fibres, fillers and pigments, all grades are notable for their good bonding strength and pigment binding capacity. The latter intensifies with increasing molecular weight, in the case of Kuraray Poval expressed by the viscosity of a 4 % aqueous solution.

This, together with the adhesive/ cohesive strength and with a number of other specific properties, allows the manufacture of unfilled to highly filled systems for a variety of uses.

Properties of Poval films

The properties of PVA films are governed mainly by the grade of Kuraray Poval used.

The water resistance of dried PVA-based films increases with increasing molecular weight and degree of hydrolysis.

It can be improved still further by heat-treating the dried film at a temperature of, for instance, 120 °C. Another possible way of improving the water resistance is to add acids such as ortho-phosphoric acid or salts such as ammonium chloride, sodium bichromate or ammonium bichromate in the Poval solution in a quantity of 5 % by weight, relative to PVA. Other products that can be used to increase the water resistance are aldehydes such as formaldehyde or glyoxal, and also urea-formaldehyde resins and melamine-formaldehyde resins in quantities of 10 - 20 % by weight, relative to the PVA.

Ultraviolet radiation on the dried PVA film also enhances water resistance.

Plasticizers for PVA are polyhydric alcohols e.g. glycerol, neopentyl glycol, trimethylol propane, ethylene glycol, di- and tri-ethylene glycol and polyethylene glycols up to a molecular weight of approximately 400 and in quantities of up to 30 % by weight, relative to PVA.

PVA as an adhesive raw material

PVA is used in a similar manner as natural products such as casein as well as starch and its degraded derivatives (for example dextrins) as raw material for the production of aqueous adhesive solutions.

Compared to dextrins and casein PVA has the advantage of a more uniform chemical structure and greater adhesion, being obtained with minimum raw material requirements.

Water-activated adhesives

Remoistenable adhesives are employed mainly in the paper processing industry. Very familiar uses are the gumming of paper on the reverse side (e.g. postage stamps and labels) and the application of gum to the flaps of envelopes and Jiffy®-type bags. Partially hydrolysed PVA grades with low to medium viscosity, e.g. KURARAY POVAL 5-88 are particularly suitable for this function. To produce the adhesive, PVA solutions of up to 30 % are applied according to the viscosity requirements The addition of preservative is recommended.

Drying to the adhesive can be accelerated by adding alcohols. The drying temperature must be as low as possible and on no account exceed 130°C, since otherwise this will make the gummed surface more difficult to be activated.

The open time of the adhesive depends on the grade of PVA employed. Increasing viscosity of a 4 % PVA solution is generally accompanied by decreasing open time.

An applied quantity of some 10 g KURARAY POVAL 5-88 solid per m2 allows the production of coatings with very good remoistening properties and the following advantages:

- high degree of flatness during storage under fluctuating air humidity
- colourless, flexible coatings
- minimal blocking tendency, even in high air humidity
- fast setting after reactivation

Wet bonding

Higher-viscous and fully hydrolysed polymers such as KURARAY POVAL 28-98 are preferred if the adhesives are intended for the production of bonds resistant to cold water. These are used for such applications as the manufacture of special paper laminates (card-board), spiral tubes and sealing materials for packaging. Usually these PVA grades also possess higher "wet tack”.

Aqueous adhesives based on PVA can also be extended with fillers such as china clay. Even with

ratios of approx. 2 parts by weight of filler to 1 part by weight of PVA it is still possible to obtain firm bonds in the winding of spiral tubes or the plane-surface bonding of paper and cardboard.

Modification of emulsion adhesives

Aqueous solutions of PVA can be added to polymer emulsions already stabilized with polyvinyl alcohol. This affects the

- extension of the open time
- increase of the setting speed
- influence on the rheology

The open time is very important in such operations like the manual or machine bonding of wood and paper.

In a number of polymer emulsions the addition of PVA solution increases the bonding speed considerably. Additions of up to 10 % of an approx. 15 % solution of PVA to the polymer emulsion have proved to be suitable for this purpose.

The choice of PVA grades is primarily dependent on the viscosity required in the ready-to-use adhesive.

Generally speaking, preference should be given to partially hydrolysed PVA grades on account of their faster solubility at lower temperatures.

In emulsion adhesives suitable for application by dip wheel or roller on applicator machines the addition of PVA solutions has the advantage of largely preventing skin formation during processing.

The combination of PVA grades with cellulose-stabilized polyvinyl acetate emulsions is also possible, but storage stability needs to be checked.

PVA as protective colloid

PVA grades, preferably of the partially hydrolysed range, are used as protective colloids in the polymerization of polymer emulsions. Because of their ability to anchor to the surface of the polymer particles that form, they help to stabilize the polymer emulsion during and after polymerization. Those PVA types influence not only particle size distribution but also the application properties such as viscosity, stability to stirring, the freeze/thaw stability, pigment compatibility, electrolyte stability and open time of the emulsion.

PVA as binder in textile sizes

The use of PVA as a binder in sizes is based on its good penetration capacity and good adhesion properties on all types of fibrous material. The excellent film characteristics of PVA like high cohesion and toughness, low electrostatic charging and redissolving capacity of the dried film in water complete the characterisation of this polymer as suitable agent for this purpose.

PVA as a versatile auxiliary aid in paper applications

Due to its broad property profile PVA is frequently used as a co-binder in paper coatings. The particular suitability of PVA in pigmented coatings is based on its

- outstanding carrier properties to optical brightening agents
- excellent colloidal protection becoming effective in high solids pigment formulations which establishes a smooth viscosity profile
- good water retention in coating colours
- high binding strength in paper coatings which can be related to polymer cohesion as well as to good adhesion to the fibre and to the pigment particles, respectively

PVA possesses remarkable barrier properties. Due to its insolubility in most organic solvents surfaces treated with PVA repel hydrophobic products such as oil, grease and fat. Furthermore, PVA displays excellent mechanical strength properties if applied as a film on paper or paperboard. Therefore it fits well as a surface sizing agent. Many special paper grades are produced using PVA, such as

- silicon base paper, to be used as release paper for pressure sensitive adhesive (PSA) labels
- banknote paper and grades with high folding endurance
- thermoreactive paper for bar code labels or facsimile machines
- film casting (release) paper
- ink-jet paper

Processing

Preparation of PVA solutions

In the adhesives sector PVA is processed as an aqueous solution, as it is in most other fields of application. The solution should be prepared in corrosion-resistant vessels.

As a first step PVA is sprinkled into cold water during stirring and heated to 90 - 95 °C in a water bath or by the use of live steam.

The solution should be stirred during cooling in order to prevent skin formation.

The partially hydrolysed PVA grades dissolve in water. The speed of dissolution increases with increasing temperature. For both partially and fully hydrolysed PVA grades the speed of dissolution decreases with increasing molecule size (i.e. increasing viscosity of the 4 % aqueous solution). The dissolving process is also made more difficult when there is a transition to higher concentrations. As a result, even more highly concentrated PVA solution, e.g. 30 % solution of KURARAY POVAL 5-88, should be produced at temperatures of 90 – 95°C.

Polyvinyl alcohol solutions may produce foam stirred or during transport in pipelines, but this can

be largely prevented by using a suitable stirrer design such as a low-speed anchor stirrer or by avaoiding steep downward gradients in the pipelines.

Suitable defoamers are n-octanol, tributyl phosphate, Foamaster® 223[1)] and the Agitan® grades[2)] 301, 305 and 731, which are used in quantities of up to approx. 0.001 - 0.010 % relative to the solution.

Polyvinyl alcohol solutions which have been stored for lengthy periods may increase in viscosity. This is especially true of fully hydrolysed grades in high concentrations and at low temperature. The original viscosity can be restored by heating and stirring.

Preservation

PVA in the form of an aqueous solution can be attacked by micro-organisms under certain conditions. In the acidic pH range the main organisms reproduced are the fission fungi, whilst bacteria grow most readily in a neutral to weakly alkaline medium.

The solution can be preserved from any micro organism attack by adding a preservative. Products which have proved especially suitable for the purpose are for example the Mergal® grades[3)] K9N and K14. The dosage depends on the concentration of the solution, the storage temperature and the nature and intensity of the infection. Quantities of about 0.01 - 0.2 % by weight preservative, relative to the PVA solution, are generally sufficient. Compatibility and efficiency must be tested. Information on the quantity to be used is available from the suppliers.

It is advisable for the PVA solution to be prepared and stored in clean containers. Considering the resistance that may be shown by some micro-organisms to the preservatives employed, the dissolving vessel in particular, together with the filling equipment (pipes, valves, tubing etc.), needs to be kept clean. Any skins or incrustations should be removed. In the event of complications the possibility of changing to a different preservative must be considered.

Certain applications for PVA in solution (cosmetic preparations, finger paints etc.) require the preservatives employed to be of approved types and physiologically inert. In such instances it is essential for the relevant legal regulations regarding physiological effects to be taken into account.

Storage

PVA can be stored for an unlimited period of time under appropriate conditions that is in its original packs in closed, dry rooms, at room temperature.

Industrial Safety and Environmental Protection

Not classified as a dangerous substance or preparation according to the current criteria of chemical legislation, or of the EU Directives 67/548/EC.

A safety data sheet is available on request.

Special remarks

Status as governed by foodstuffs legislation

Refer to the Poval Brochure Regulatory information.

[1)] Cognis Deutschland GmbH, Düsseldorf, Germany
[2)] Münzing Chemie GmbH, Heilbronn, Germany
[3)] Troy Chemie GmbH., Seelze, Germany

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