

®Mowiol

Technical data sheet

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.

Form supplied

Granules

Data

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

Grade		Viscosity ¹⁾	Degree of hydrolysis	Ester value	Residual acetyl content	Max Ash content ²⁾
		DIN 53015	(saponification)	DIN 53401	content	
		[mPa · s]	[mol.-%]	[mgKOH/g]	[w/w-%]	[%]
Partially hydrolysed grades	Mowiol 15-79	15 ± 2,0	81,5 ± 2,2	200 ± 20	15,4 ± 1,6	0,5
	Mowiol 3-85	3,7 ± 0,3	85,2 ± 1,0	165 ± 10	12,6 ± 0,8	0,5
	Mowiol 4-88	4 ± 0,5	87,7 ± 1,0	140 ± 10	10,8 ± 0,8	0,5
	Mowiol 5-88	5,5 ± 0,5	87,7 ± 1,0	140 ± 10	10,8 ± 0,8	0,5
	Mowiol 8-88	8 ± 1,0	87,7 ± 1,0	140 ± 10	10,8 ± 0,8	0,5
	Mowiol 13-88	13 ± 1,5	87,7 ± 1,0	140 ± 10	10,8 ± 0,8	0,5
	Mowiol 18-88	18 ± 1,5	87,7 ± 1,0	140 ± 10	10,8 ± 0,8	0,5
	Mowiol 23-88	23 ± 1,5	87,7 ± 1,0	140 ± 10	10,8 ± 0,8	0,5
	Mowiol 26-88	26 ± 1,5	87,7 ± 1,0	140 ± 10	10,8 ± 0,8	0,5
	Mowiol 32-88	31 ± 3,0	87,7 ± 1,0	140 ± 10	10,8 ± 0,8	0,5
	Mowiol 40-88	40 ± 2,0	87,7 ± 1,0	140 ± 10	10,8 ± 0,8	0,5
	Mowiol 47-88	47 ± 2,0	87,7 ± 1,0	140 ± 10	10,8 ± 0,8	0,5
	Mowiol 56-88	56 ± 4,0	87,7 ± 1,0	140 ± 10	10,8 ± 0,8	0,5
Fully hydrolysed grades	Mowiol 30-92	30 ± 2,0	92,4 ± 0,9	90 ± 10	6,9 ± 0,8	0,5
	Mowiol 3-96	3,3 ± 0,5	97,2 ± 0,4	35 ± 5	2,7 ± 0,4	1,0
	Mowiol 4-98	4,5 ± 0,5	98,4 ± 0,4	20 ± 5	1,5 ± 0,4	0,5
	Mowiol 6-98	6 ± 1,0	98,4 ± 0,4	20 ± 5	1,5 ± 0,4	0,5
	Mowiol 10-98	10 ± 1,0	98,4 ± 0,4	20 ± 5	1,5 ± 0,4	0,5
	Mowiol 20-98	20 ± 1,5	98,4 ± 0,4	20 ± 5	1,5 ± 0,4	0,5
	Mowiol 30-98	30 ± 2,0	98,4 ± 0,4	20 ± 5	1,5 ± 0,4	0,5
	Mowiol 56-98	56 ± 4,0	98,4 ± 0,4	20 ± 5	1,5 ± 0,4	1,0
	Mowiol 15-99	15 ± 2,5	99,4 ± 0,4	8 ± 5	0,6 ± 0,4	0,5
	Mowiol 28-99	28 ± 2,0	99,4 ± 0,4	8 ± 5	0,6 ± 0,4	0,5

¹⁾ of a 4 % aqueous solution at 20 °C

²⁾ calculated as Na₂O

Additional data, valid for all Mowiol grades

Non-volatile content min. 95 % (after 3 hours' drying at 105 °C/DIN 53189).

Methanol content: less than 3 %.

pH of a 4 % solution in distilled water (DIN 19261): 4.5 - 7 partially and fully hydrolysed grades.

Bulk density (DIN 53466): approx. 0.4 - 0.6 gcm⁻³, depending on grade.

The test methods for determining the data are fully described in our "Mowiol-Polyvinyl alcohol" brochure.

The first number in the nomenclature denotes the viscosity of the 4 % aqueous solution at 20 °C as a relative measure for the molar mass of the Mowiol; the second number denotes the degree of hydrolysis of the polyvinyl acetate from which the Mowiol grade is derived. There is a subdivision into "partially hydrolysed" and "fully hydrolysed" grades.

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. A distinction is drawn between partially hydrolysed and fully hydrolysed polyvinyl alcohols.

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

the first number of the grade designation.

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 Mowiol films

The properties of Mowiol films are governed mainly by the grade of Mowiol used.

The water resistance of dried Mowiol-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 of Mowiol films is to add acids such as orthophosphoric acid or salts such as ammonium chloride, sodium bichromate or ammonium bichromate in the Mowiol solution in a quantity of 5 % by weight, relative to Mowiol. 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 Mowiol.

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

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

Mowiol as an adhesive raw material

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

Compared to dextrans and casein Mowiol 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 Mowiol grades with low to medium viscosity, e.g. Mowiol 4-88 are particularly suitable for this function. To produce the adhesive, Mowiol solutions of up to 30 % are applied according to the viscosity requirements, these solutions containing additions of preservative and defoamer if necessary.

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

An applied quantity of some 10 g Mowiol 4-88 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 Mowiol 20-98, 28-99 and 56-98 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 (cardboard), spiral tubes and sealing materials for packaging. Usually these Mowiol grades also possess higher "wet tack".

Aqueous adhesives based on Mowiol can also be extended with fillers such as china clay. Even with ratios of approx. 2 parts by weight filler to 1 part by weight Mowiol 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 Mowiol can be added to polymer emulsions already stabilized with polyvinyl alcohol. This effects

- 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 Mowiol solution increases the bonding speed considerably. Additions of up to 10 % of an approx. 15 % solution of Mowiol to the polymer emulsion have proved to be suitable for this purpose.

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

Generally speaking, preference should be given to partially hydrolysed Mowiol 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 Mowiol solutions has the advantage of largely preventing skin formation during processing.

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

Mowiol as protective colloid

Mowiol 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 Mowiol 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.

Mowiol, Binder in textile sizes

The use of Mowiol 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 Mowiol 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.

Mowiol as a versatile auxiliary aid in paper applications

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

- its outstanding carrier properties to optical brightening agents
- its excellent colloidal protection becoming effective in high solids pigment formulations which establishes a smooth viscosity profile
- its good water retention in coating colours
- its 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

Low molecular weight Mowiol grades such as Mowiol 4-98 and Mowiol 6-98 are the preferred polyvinyl alcohols to be used in paper coatings.

Mowiol possesses remarkable barrier properties. Due to its insolubility in most organic solvents surfaces treated with Mowiol repel hydrophobic products such as oil, grease and fat. Furthermore, Mowiol 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 Mowiol, such as

- silicon base paper, to be used as release paper for 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 Mowiol solutions

In the adhesives sector Mowiol 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 Mowiol 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 Mowiol grades dissolve in water much faster than the fully hydrolysed grades. The speed of dissolution increases with increasing temperature. For both partially and fully hydrolysed Mowiol grades the speed of dissolution decreases with increasing molecule size (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 a more highly concentrated Mowiol solution, e.g. a 30 % solution of Mowiol 4-88, should be produced at temperatures of 90 -95 °C.

Polyvinyl alcohol solutions may produce foam when 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 avoiding steep downward gradients in the pipelines.

Suitable defoamers are n-octanol, tributyl phosphate, ®Foamaster 223¹⁾ and the ®Agitan grades²⁾ 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 temperatures. The original viscosity can be restored by heating and stirring.

Preservation

Like any other polyvinyl alcohol, Mowiol 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 grades³⁾ 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 Mowiol 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 Mowiol 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 Mowiol 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

Mowiol 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/EEC and 1999/45/EEC.

A safety data sheet is available on request.

Special remarks

Status as governed by foodstuffs legislation

According to various recommendations of the Bundesinstitut für Risikobewertung (German Federal Institute for Risk Assessment), BfR, polyvinyl alcohol such as Mowiol 18-88 can be used in the production of essential commodities within the meaning of the German Foodstuffs and Essential Commodities Law, § 5, and of the US Code of Federal Regulations, title 21, food and drugs.

Examples are the Recommendations II, Plasticizer-free PVC, XIV, Synthetic resin emulsions, and XXXVI, Paper and cardboard in contact with foodstuffs of the German Federal Institute for Risk Assessment, considering the limitations mentioned therein concerning quantities and viscosity.

Polyvinyl alcohol such as Mowiol 18-88 is also sanctioned by the EC plastics directive 2002/72/EC (all monomers and starting substances authorised by listing in Annex II, Section A) as well as by Council of Europe, Resolution AP 96(5) on surface coatings intended to come into contact with foodstuffs - (all monomers and starting substances authorised by listing in appendix II, list 1).

Examples for FDA are the §§ 175.105 Adhesives, 175.300 Resinous and polymeric coatings, 176.170/176.180 Components of paper and paperboard in contact with aqueous and fatty foods/with dry food, 177.1670 Polyvinyl alcohol film.

Because of their low viscosity the Mowiol grades 4-88, 3-96, and 4-98 in the fields of application mentioned above can only be

used to a limited extent or not at all.

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

This information is based on our present state of knowledge and is intended to provide general notes on our products and their uses. It should therefore not be construed as guaranteeing specific properties of the products described or their suitability for a particular application. Any existing industrial property rights must be observed. The quality of our products is guaranteed under our General Conditions of Sale.

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