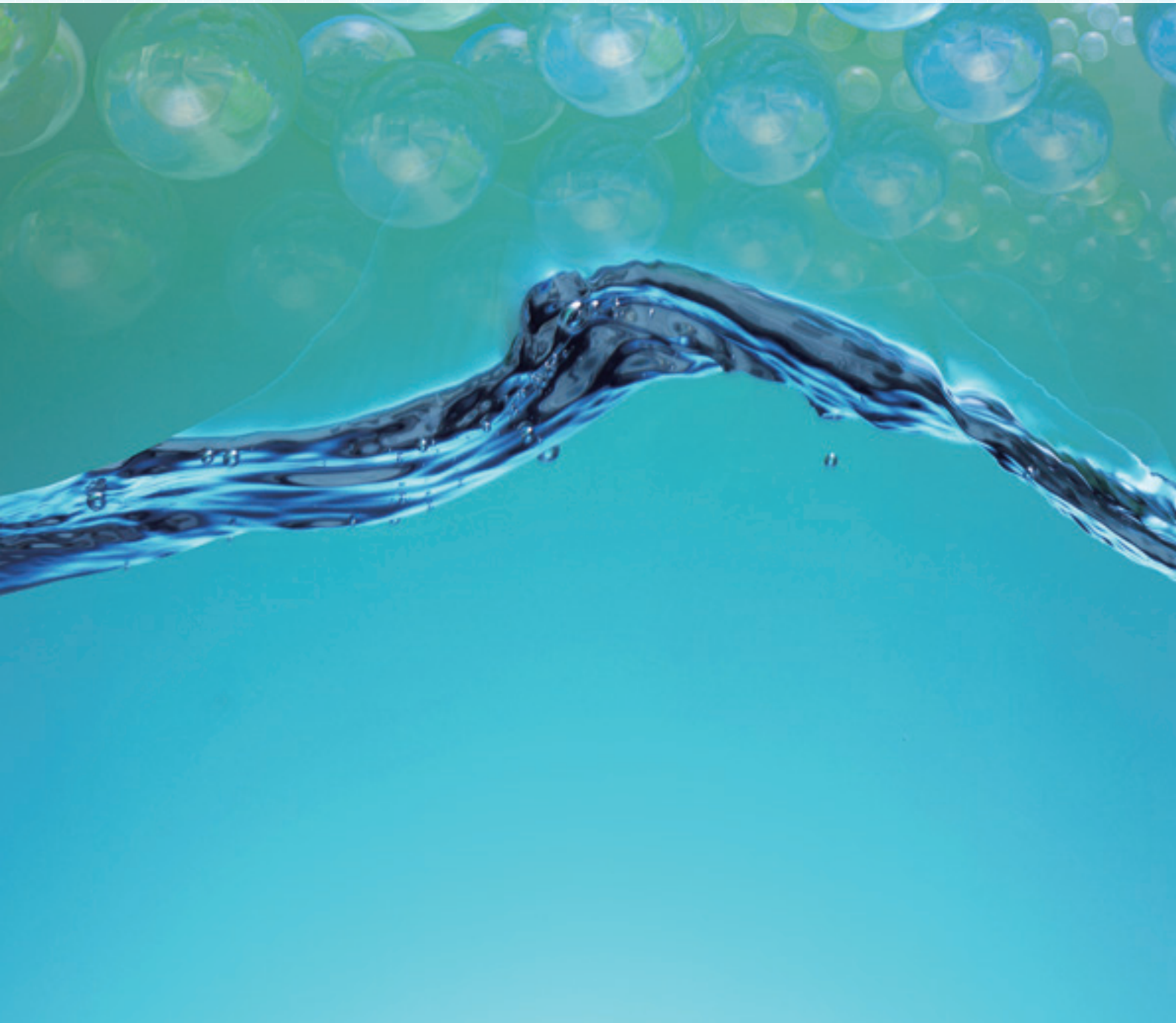


DENKA POVAL

(Polyvinyl Alcohol)



Denka

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1 Introduction

DENKA POVAL is a water-soluble polymer described in below chemical formula, and provided as granule or powder form. POVAL (Polyvinyl alcohol) is used in a variety of fields because of its excellent properties such as water-solubility, adhesion strength, mechanical strength, gas barrier and aging resistance.

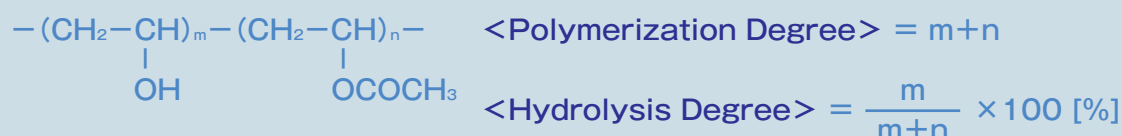


Fig. 1 Chemical Formula of POVAL

2 Production Process of DENKA POVAL

DENKA POVAL is made from vinyl acetate monomer through polymerization and saponification processes. There are many grades available in the market according to different degrees of polymerization and hydrolysis, which are controlled in the polymerization and the saponification processes respectively.

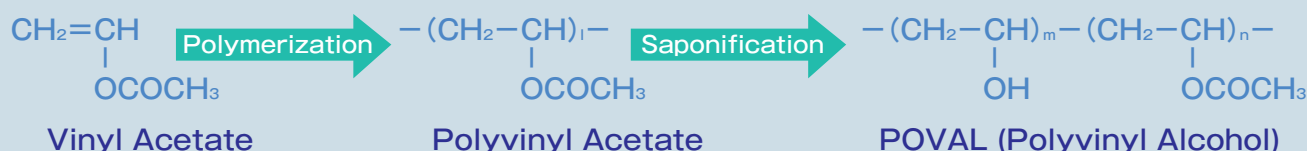


Fig. 2 Production flow of DENKA POVAL



DENKA Omi-Plant

3 Classification and Grades of DENKA POVAL

DENKA POVAL can be classified mainly with polymerization degree, which is often indicated as solution viscosity, and hydrolysis degree. Modified grades are also available to satisfy specified requirements. The most suitable grade can be selected from the range of DENKA POVAL.

Table 1 DENKA POVAL General Grades List

Classification	Grade	Hydrolysis Degree [mol-%]	Viscosity (4%, 20°C) [mPa·s]	pH (4%, 25°C)	Volatile Matter [%]	Sodium Acetate [%]	Product Shape		
							G	P	F
Fully Hydrolyzed	K-05	98.0 ~ 99.0	5.2 ~ 6.6	5.0 ~ 7.0	≤5.0	≤1.5	●		
	K-17E	97.5 ~ 99.2	26 ~ 32	5.0 ~ 7.0	≤5.0	≤1.0	●		
	K-17C	98.7 ~ 99.7	24 ~ 30	5.0 ~ 7.0	≤5.0	≤1.2		●	●
	K-24E	98.5 ~ 99.9	54 ~ 74	5.0 ~ 9.0	≤5.0	≤1.5	●		
Medium Hydrolyzed	H-12	95.0 ~ 96.5	10 ~ 15	5.0 ~ 7.0	≤5.0	≤1.0		●	
	H-17	95.0 ~ 96.0	25 ~ 31	5.0 ~ 7.0	≤5.0	≤1.0	●	●	
	H-24	95.0 ~ 96.0	52 ~ 64	5.0 ~ 7.0	≤5.0	≤1.0	●	●	
Partially Hydrolyzed	B-04	88.0 ~ 90.0	3.4 ~ 4.1	5.0 ~ 7.0	≤5.0	≤1.5	●		
	B-05	86.5 ~ 89.5	5.0 ~ 6.0	5.0 ~ 7.0	≤5.0	≤1.5	●		●
	B-17	87.0 ~ 89.0	21 ~ 25	5.0 ~ 7.0	≤5.0	≤1.0	●		●
	B-20	87.0 ~ 89.0	27 ~ 33	5.0 ~ 7.0	≤5.0	≤1.0	●	●	●
	B-24	86.0 ~ 89.0	40 ~ 48	5.0 ~ 7.0	≤5.0	≤1.0	●	●	●
	B-33	87.0 ~ 89.0	98 ~ 122	5.0 ~ 7.0	≤5.0	≤1.0		●	

* Product Shape : G = Granule, P = Powder, F = Fine Powder

Table 2 DENKA POVAL Special & Unique Grades List

Classification	Grade	Characteristics	Main Application	Hydrolysis Degree [mol-%]	Viscosity (4%, 20°C) [mPa·s]	pH (4%, 25°C)	Product Shape		
							G	P	F
DENKA POVAL	K-177	Fine Powder	Int. Binder	≥99.0	26 ~ 31	5.0 ~ 7.0			●
DENKA SIZE	NP-05F	Low Hydrolyzed	Fiber	76.5 ~ 81.0	(4 ~ 7)	5.0 ~ 7.0	●		
	U-12	High Hydrolyzed	Adhesive	≥99.5	11.5 ~ 15.5	6.0 ~ 11.5		●	
	PC-1000	for Offset Printing	Paper	Fully Hydro.	20 ~ 30	5.0 ~ 7.0		●	
	PC-2000	High Barrier Property	Paper	Fully Hydro.	85 ~ 125	5.0 ~ 7.0		●	
	PC-5000F	Low Staining Property	Paper	Fully Hydro.	20 ~ 30	(5.0 ~ 7.0)		●	
	PC-5500	Low Staining Property	Paper	Fully Hydro.	20 ~ 30	(6.0 ~ 9.0)		●	
HV Polymer	W-100	Water Resistance	Paper	Fully Hydro.	500 ~ 1500*	5.0 ~ 7.0		●	
	D-100	Hydrophobic Modified	Adhesive	86.5 ~ 89.0	43 ~ 70*	—	●		●
	F-300S	Hydrophobic Modified	Binder	93.0 ~ 97.0	100 ~ 350*	—			●
Dispersant	EP-130	Hydrophobic Modified	Adhesive	96.0 ~ 98.0	110 ~ 180	5.0 ~ 7.5	●		
	B-24N	High Dispersing Ability	Emulsion	86.0 ~ 89.0	40 ~ 48	5.0 ~ 7.0	●		
	W-20N	High Dispersing Ability	PVC	78.5 ~ 80.5	37 ~ 43	5.0 ~ 7.0	●		
	W-24N	High Dispersing Ability	PVC	78.5 ~ 80.5	44 ~ 55	5.0 ~ 7.0	●		
	MP-10	Double Bond Modified	PVC	70.5 ~ 74.5	9.0 ~ 13.0	5.0 ~ 7.5	●		
	MP-10R	Double Bond Modified	PVC	70.5 ~ 74.5	6.0 ~ 9.0	5.0 ~ 7.5	●	●	

* Solid Content in Viscosity Measurement : W-100 = 12.5%, D-100 = 2%, D-300F = 3%

* Product Shape : G = Granule, P = Powder, F = Fine Powder

DENKA SIZE : Suitable especially for fiber sizing, paper sizing and adhesive applications. Softness, water resistance, adhesion strength and wettability can be improved.

HV Polymer : Modified grades suitable for adhesive and binder applications. Superior control can be provided in viscosity and bonding strength.

Dispersant : Suitable for a dispersant or an emulsifier for the polymerization of vinyl acetate emulsion and vinyl chloride. High dispersing effect can be provided.

4 Characteristics and Basic Properties of DENKA POVAL

The characteristics of PVA are strongly influenced from polymerization and hydrolysis degrees. Figure 3 shows the relationship of polymerization and hydrolysis degrees of typical grades of DENKA POVAL.

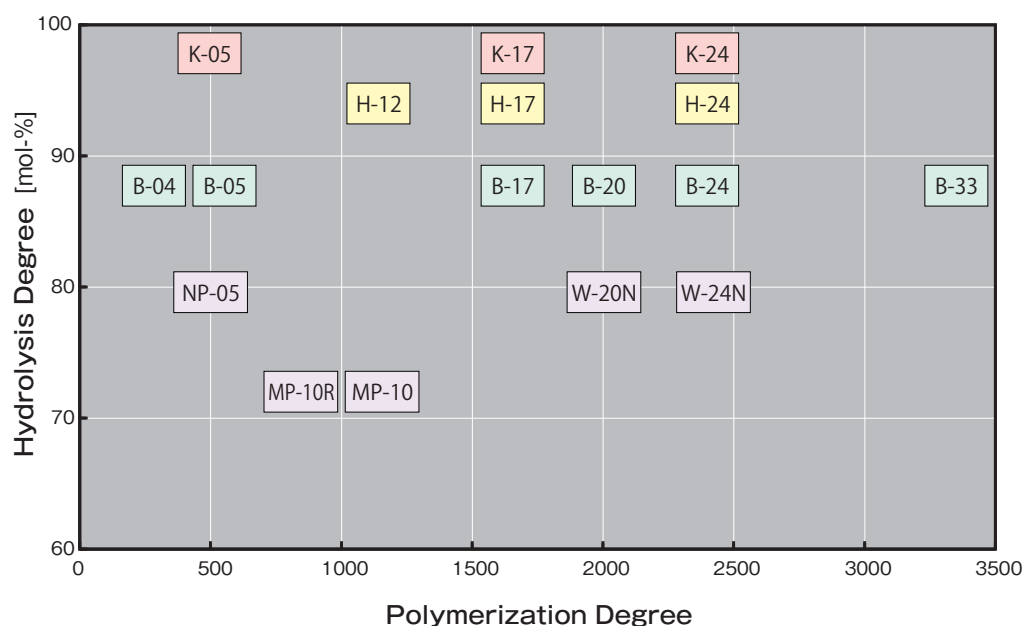


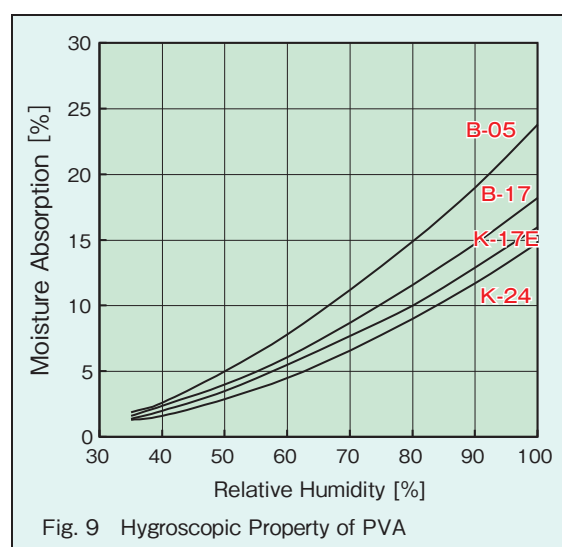
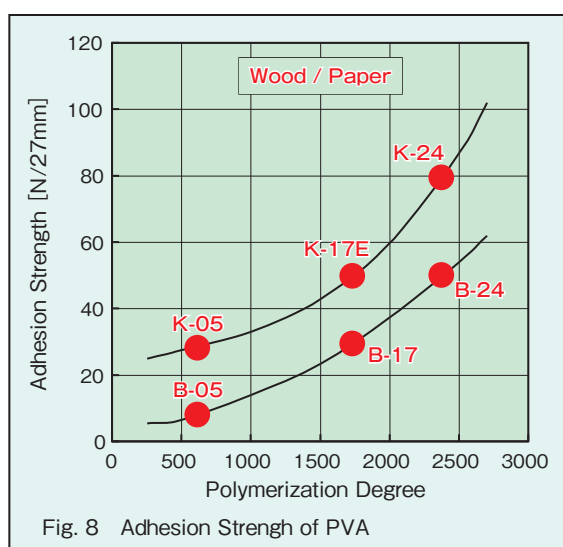
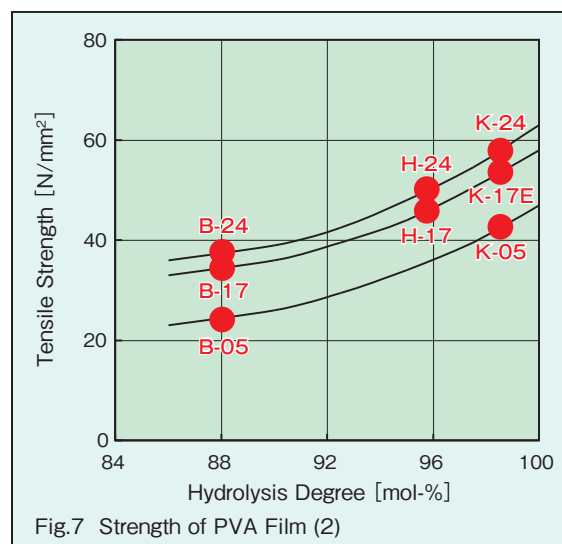
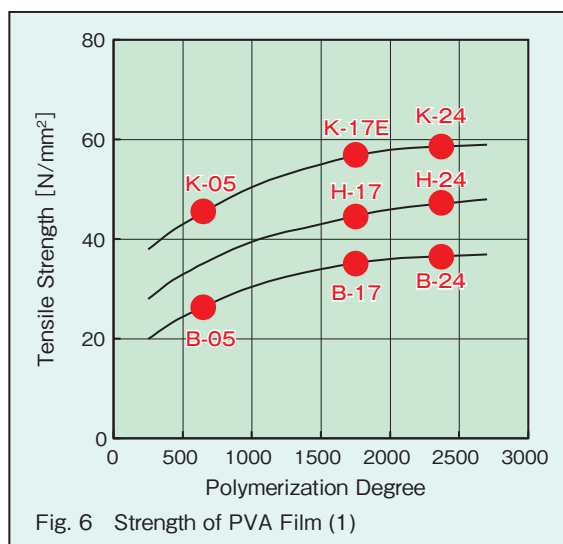
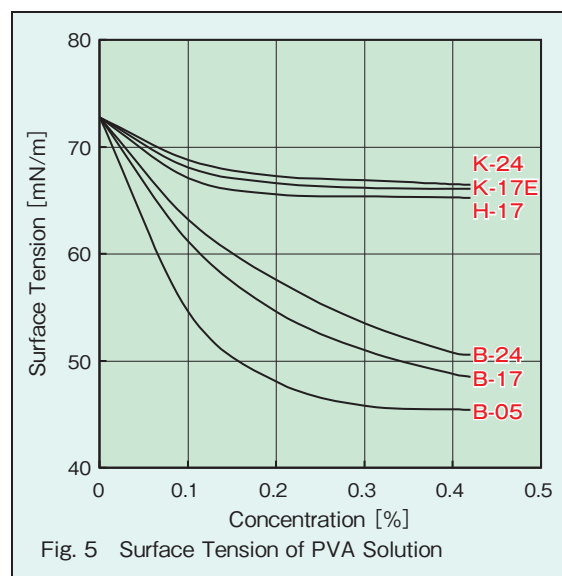
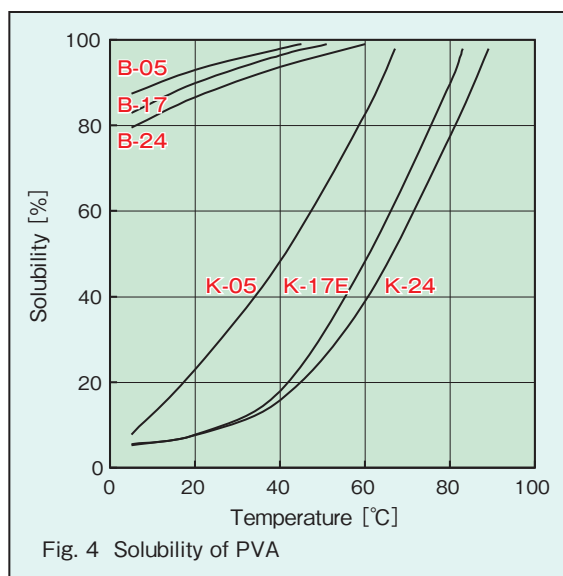
Fig. 3 Relation between Polymerization & Hydrolysis Degrees of DENKA POVAL

Figure 4 shows schematically the influences of polymerization and hydrolysis degrees against the basic properties of PVA. The performance of PVA changes widely in dependence with polymerization and hydrolysis degrees.

Table 3 Influences of Polymerization and Hydrolysis Degrees against PVA Properties

	Polymerization Degree		Hydrolysis Degree	
	Low	High	Low	High
Solubility, Hygroscopicity	Large	Small	Large	Small
Solution Viscosity	Small	Large	Small	Large
Film Strength	Small	Large	Small	Large
Emulsifying Capacity	Small	Large	Large	Small

Examples of the experimental data of the effects of polymerization and hydrolysis degrees are shown in figure 4~13 in the next pages. And basic properties of PVA are shown in Table 4.



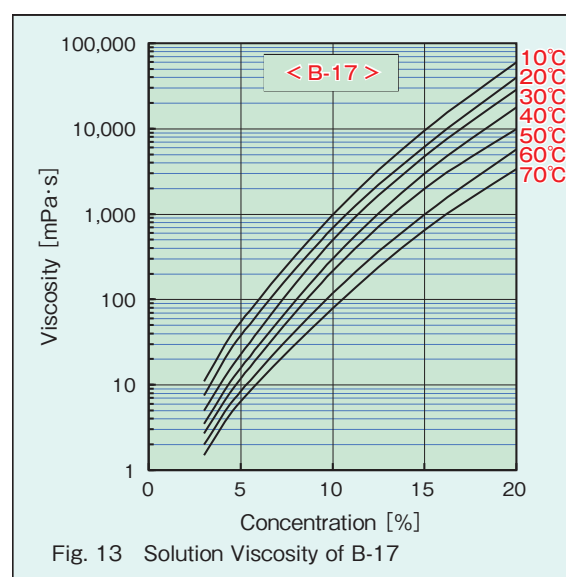
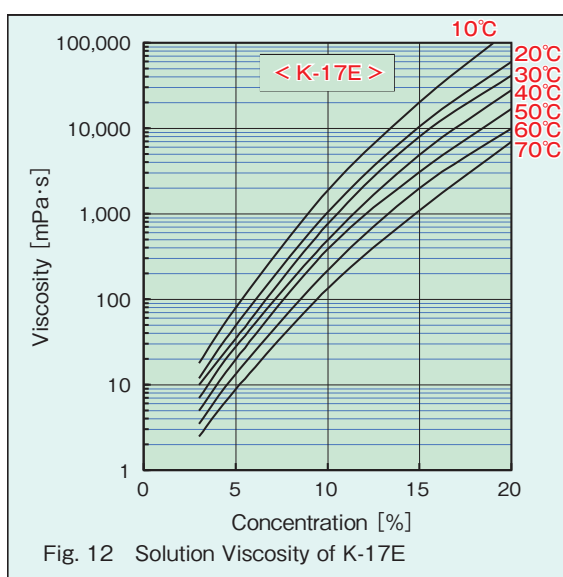
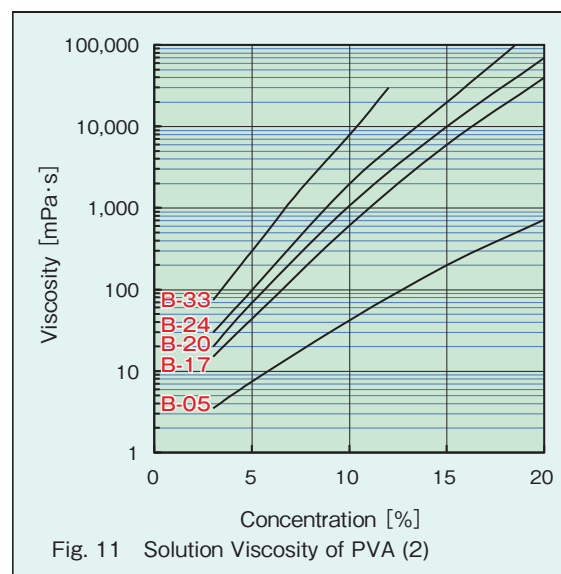
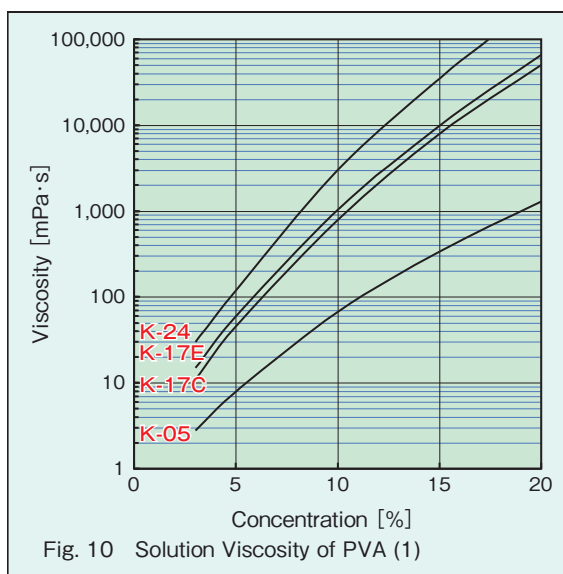


Table 4 Basic Properties of PVA

Item	Property	Note
Appearance	White to light yellow, granule or powder	
Specific Gravity	1.19 ~ 1.31	
Bulk Density	0.3 ~ 0.7	
Specific Heat	$1.681 \times 10^3 \text{ J/(kg} \cdot ^\circ\text{C)}$	
Glass Transition Temp.	85°C (Fully) / 58°C (Partially)	Depends on Hydrolysis Degree
Heat Conductivity	$\sim 2 \text{ W/(m} \cdot ^\circ\text{C)}$	
Thermal Expansion	$7 \sim 10 \times 10^{-5} / ^\circ\text{C}$	Between 0 ~ 45°C
Refractive Index (nD ²⁰)	1.52 ~ 1.55	
Electric Resistance	$3.1 \sim 3.8 \times 10^7 \Omega \cdot \text{cm}$	

5 Typical Applications of DENKA POVAL

DENKA POVAL is widely used as a water-soluble polymer in a variety of fields because of its excellent properties such as adhesion, film-forming and dispersing ability. Table 5 shows typical applications of PVA and suitable PVA grade for each application.

Table 5 Typical Applications of DENKA POVAL

Classification	Grade	Applications													
		Fiber		Paper		Dispersant		Adhesive				Binder			
		Span	Filament	Finishing Glue	Surface Sizing	Pigment Coating	VAM Emulsion	PVC	Papers	Paper Band	Remoistenable	Urea Resin	Internal Binder	Ferite	Ceramics
Fully Hydrolyzed	K-05					●	●				●				●
	K-17E	●		●	●	●	●		●	●			●	●	●
	K-17C	●		●	●	●			●	●		■	■	●	●
Medium Hydrolyzed	H-12						●								
	H-17	●					●		●						
	H-24						●		●						
Partially Hydrolyzed	B-05		●			●	●	●			●		●	●	●
	B-17	●	●			●	●		●		●		●	●	●
	B-20	●				●	●	●					●	●	●
	B-24					●	●	●							●
	B-33					●	●								●
DENKA POVAL	K-177											●	●		●
DENKA SIZE	NP-05F	●	●			●					●				
	EP-130					●									
	U-12											●	●		
	PC-1000				●				●						
	PC-2000				●										
	PC-5000F				●										
	PC-5500				●										
HV Polymer	D-100						●					●			●
	F-300S											●			●
Dispersant	B-24N					●	●								●
	W-20N						●								
	W-24N						●								
	MP-10						●								
	MP-10R						●								

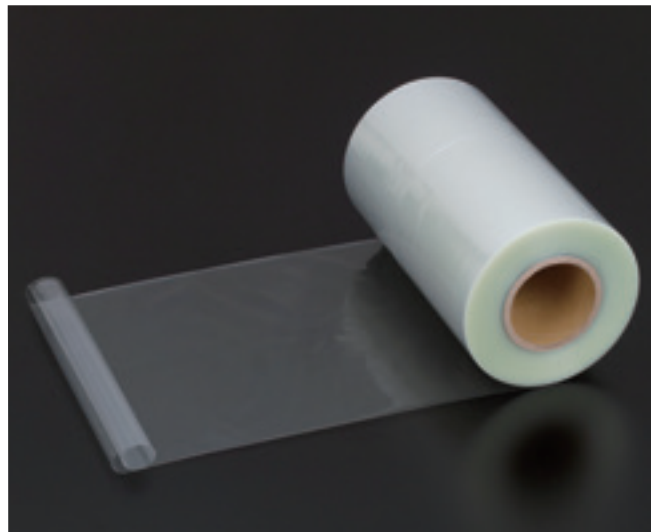
* Note ● : Suitable ■ : Fine powder is recommended

Detailed report for each application is available. If required, please contact our sales department which is described on the back cover of this catalog.

Typical Applications of DENKA POVAL



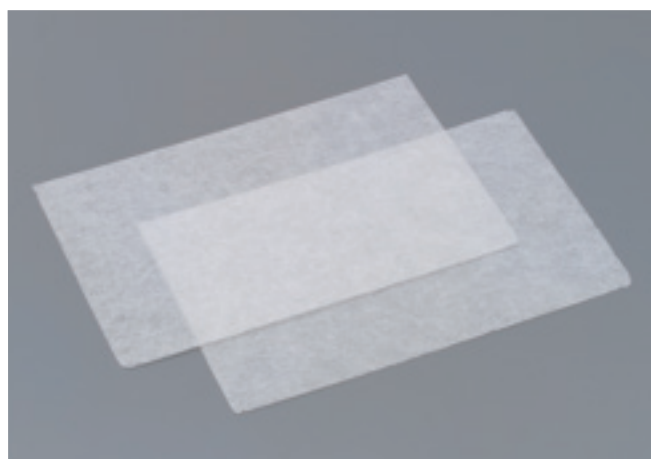
Vinylon Fiber



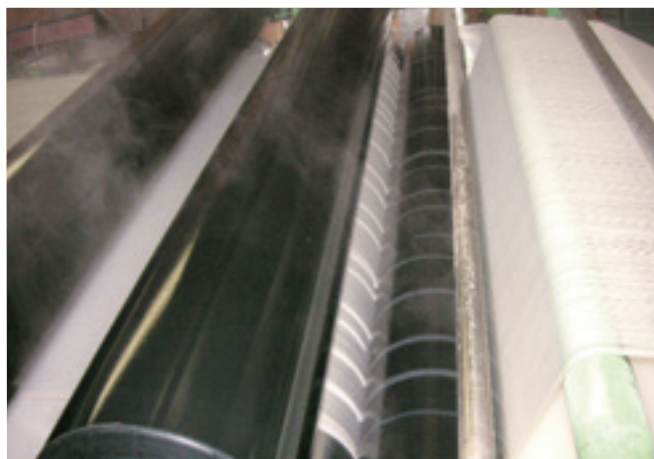
Vinylon Film



Emulsion Type Adhesive



Glass Paper



Fiber Sizing



PVA Sponge

6 How to Use DENKA POVAL

Usage of DENKA POVAL is briefly explained on this page. Detailed information is available on a request basis. Please contact our sales department, if required.

1) Dissolving Procedure

Following procedure is recommended to dissolve PVA.

- ① Feed water into a tank at ambient temperature
 - ⇒ Water temperature should not be so high in order to avoid agglomeration.
- ② Feed PVA gradually into the water with agitation and disperse it sufficiently.
 - ⇒ Especially low hydrolyzed grade should be taken care of.
- ③ Heat up with continuous agitation and dissolve the PVA.
 - ⇒ More than 90 degree-C for minimum 30 minutes is recommended.
- ④ Add water to adjust the concentration after complete dissolution of PVA.
 - ⇒ Actual concentration should be measured due to the water contained in PVA.
- ⑤ If the grade has clouding point, cool down the temperature under the clouding point before use.
 - ⇒ Especially low hydrolyzed grade should be taken care of.



2) Additives

Following additives are sometimes used for PVA to improve a specified property.

- ① Anti-foaming Agent : Reduce the foam generation during dissolution.
- ② Water Resistant Additive : Cross-linker is often used to improve water resistance.
- ③ Plasticizer, softener : Glycerin and glycols are widely used for PVA.
- ④ Extender, Filler : Starch, other water soluble polymer and clay are used.

7 Handling Notice for DENKA POVAL

Before using DENKA POVAL, please obtain and check the material safety data sheet (MSDS). The MSDS can be obtained from DENKA upon request.

Typical notes are described below, too.

1) Chemical Information on DENKA POVAL

Chemical Name Polyvinyl Alcohol (PVA)

Trivial Name Poval

2) Handling Notice

Rubber gloves, protective goggles and dust protective mask must be worn during handling DENKA POVAL to protect skin, eyes and lung due to occurrence of fine powder.

If huge amount of DENKA POVAL is handled, a dust collector must be utilized. Countermeasure against static electricity, such as installation of groundings and use of conductive filter, is also required.

3) Storage Note

DENKA POVAL must be stored in dry, cool and well-ventilated place to prevent from blocking.

4) First Aid Measures

Eye Contact Rinse immediately with plenty of water and seek medical advice.

Skin Contact Wash off with soap and warm water.

Inhalation Move into fresh air. If symptom does not recover, call a physician.

Ingestion If swallowed, do not induce vomiting unless a physician instructs to do so.
Call a physician immediately.

5) Fire Fighting Measures

Fire Extinguishing Measure Extinguish a fire with water or fire extinguisher.

Fire Extinguishing Media Water spray jet, foam, carbon dioxide (CO₂).

6) Accidental Release Measures

Powder Sweep and collect into a container. Incinerate it if it is not reusable.

Solution Wipe up the solution or wash away with water. If amount is too much, collect the solution and then treat it with activated sludge.

7) Disposal Considerations

If disposed in solid state, incinerate it as non-hazardous solid waste.

If disposed in aqueous solution form, treat it with activated sludge.



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- Before using any of the products described in this catalog, customers should test them to determine whether they suit the customer's purpose of use and to ensure safety.
- The DENKA products described in this catalog and any products in which they are incorporated must be disposed of in compliance with all applicable laws and regulations.
- Before using any of the products described in this catalog, obtain and check the applicable technical information and product safety data sheet for information and precautions on the use of these products. These documents can be obtained from DENKA upon request.
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