BYK
Additives & Instruments

Product Guide B-G 1

Wax Additives

Waxes – Definition and Classification

What is Wax?

Waxes have been known since ancient times and in the beginning "wax" was often used as a synonym for "beeswax". Later on, other natural materials were discovered that also showed wax-like properties and in the 20th century synthetic waxes became available.
There is no generally accepted definition of waxes. A chemical description is not very meaningful, because the involved chemistries can be very diverse and not helpful in distinguishing waxes from non-wax materials. Wax is a broad term used to describe a general group of organic compounds. **Physical and technical properties** are more suitable as definitions. Among those properties are:

- Waxes are solids with a melting point above 40 °C (typically between 50 °C and 160 °C)
- They have a low melt viscosity (not more than 10 Pa·s at 10 °C above the melting point)
- They melt without decomposition
- They can be polished under slight pressure

The differentiation between waxes and organic polymers is not clear in all cases, e.g. polytetrafluoroethylene (PTFE) is often classified as a wax, but, by definition, it is not a wax, because it has no melting point.

Classification

Waxes come from a variety of sources. Besides natural waxes there are semi-synthetic waxes and synthetic waxes (figure 1).

Natural waxes can be divided into fossil waxes and waxes from living organisms (non-fossil). Paraffin wax (from crude oil) and montan wax (from coal) are good examples of fossil waxes. In the group of non-fossil waxes, beeswax and carnauba wax are typical representatives of animal and plant waxes.
One drawback of natural waxes is that they are mixtures and their compositions can vary within a certain range. Additionally, they contain impurities which cause them normally to have a yellow or even brown color. Purification such as refining and bleaching are necessary before they can be used commercially in industry.
While natural waxes are still used, their significance continues to decline. Synthetic waxes can be tailored more readily for various areas of application, and their chemical composition is much more controlled.

Semi-synthetic waxes are created in the laboratory from natural raw materials. For example, amide waxes are produced by condensation of fatty acids and amines.
An industrially important amide wax is ethylene bis-stearamide (EBS).

Synthetic waxes are the most important group today for a wide range of applications, and they can be subdivided into homopolymers and copolymers. The first synthetic waxes on the market were the Fischer-Tropsch waxes. Other homopolymer waxes such as polyethylene (LDPE, low density polyethylene and HDPE, high density polyethylene) and polypropylene waxes shortly followed. In addition to polymerization, depolymerization of high molecular weight polymers (especially in the case of polypropylene) can also be used for the production of such materials.
Copolymer waxes based on ethylene vinyl acetate (EVA) and ethylene acrylic acid (EAA) are well known in coating formulations, especially in metallic (basecoat) systems.

Origin of Waxes

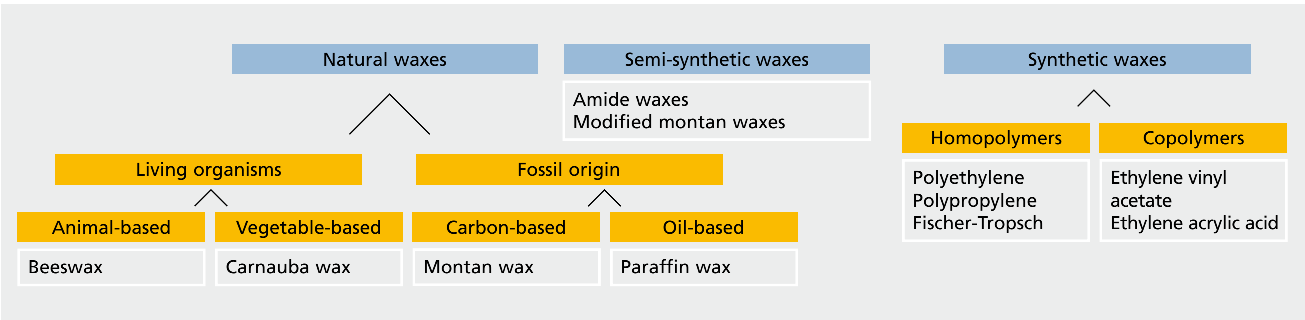

figure 1

From Waxes to Wax Additives

Waxes are solid materials and cannot be used directly in many applications (figure 3). It is necessary to convert them into **wax additives** that are easy to handle and can be readily incorporated into all types of systems.
Wax additives can be finely dispersed waxes in a liquid carrier (water or organic solvents) or micronized waxes in powder form. Micronized wax additives are ideal for solvent-free applications but they also can be easily stirred into liquid systems. Wax additives are formulations and may contain more than one type of wax. Wax combinations are often used to create wax additives with unique features.

Micronized Wax Additives

Micronized wax additives are products in powder form with an average particle size between 4 µm and 15 µm. Special types for creating textured surfaces can have particle sizes up to 90 µm. The micronized wax additives of BYK are sold under the trade name **CERAFLOUR**. Typical production processes are milling and spraying, or a combination of both. BYK uses the jet milling process for its range of micronized wax additives. In this process, wax particles are accelerated to supersonic speed (approx. 500 m/s) by an expanding air stream and the particles are reduced in size by impact.

One important quality aspect of micronized wax additives is their particle size distribution. For evaluation we use laser diffraction analysis and the data in this brochure and in our Technical Data Sheets are distributions by volume.

Aqueous Wax Additives

BYK offers three lines of wax additives with water as the liquid phase: the wax emulsions **AQUACER**, the wax dispersions **AQUAMAT**, and the primary dispersions **HORDAMER**. To produce an aqueous wax emulsion, the molten wax is mixed with hot water and an emulsifier. In the case of waxes with a melting point above 100 °C, this emulsification must be carried out under pressure. The particle size of AQUACER wax emulsions is below 1 µm and these products can therefore be used in high gloss systems without reducing gloss.
AQUAMAT wax dispersions are produced by grinding the waxes in water. Particle size is generally above 1 µm which means that these additives will cause gloss reduction in many applications.

The HORDAMER types are primary polyethylene dispersions which are manufactured by direct polymerization of ethylene in water under high pressure in the presence of emulsifiers. This process yields stable aqueous dispersions of straight, non-modified polyethylene, while the emulsification and grinding processes always require polyethylene with polar modifications.

Wax Additives Based on Organic Solvents

The **CERAFAK** and **CERATIX** product lines are produced by a precipitation process. The waxes are dissolved at an elevated temperature in non-polar solvents such as xylene and butylacetate. On cooling, e.g., by admixing cold solvents, the wax crystallizes.
CERACOL, **CERAMAT**, and **MINERPOL** are produced by a wet grinding process. CERACOL products are ground in mainly polar solvents, and CERAMAT additives are ground in mainly non-polar solvents. MINERPOL is a special range of wax additives for offset inks, where the grinding is done in the presence of mineral or linseed oils and resins.

Wax Properties

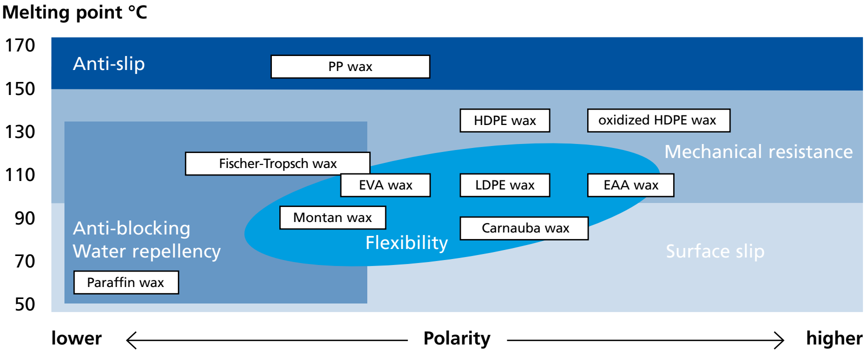

figure 2

Appearance of Waxes

figure 3

Wax Emulsions and Dispersions in Water

	Wax base	Non-volatile matter (%)	Carrier	Emulsifier system	Melting point wax component (°C)	pH value (20 °C)
Paraffin wax						
AQUACER 494	Paraffin wax	55	Water	Non-ionic/anionic	65	9
AQUACER 497	Paraffin wax	50	Water	Non-ionic	60	5.5
AQUACER 533	Modified paraffin wax	40	Water	Anionic	95	9.5
AQUACER 537	Modified paraffin wax	30	Water	Anionic	110	9.5
AQUACER 539	Modified paraffin wax	35	Water	Non-ionic	90	9.5
Carnauba wax						
AQUACER 565	Carnauba wax	30	Water	Non-ionic	85	6.5
AQUACER 581	Carnauba wax	30	Water	Non-ionic	85	7.5
AQUACER 2650	Carnauba wax	30	Water	Non-ionic	85	4.5
Polyethylene wax						
AQUACER 501	Oxidized HDPE wax	35	Water	Non-ionic	130	9
AQUACER 506	Oxidized HDPE wax	35	Water	Non-ionic/anionic	120	9
AQUACER 507	Oxidized HDPE wax	35	Water	Anionic	130	9.7
AQUACER 513	Oxidized HDPE wax	35	Water	Non-ionic	135	9.2
AQUACER 517	Oxidized HDPE wax	35	Water	Non-ionic	120	9
AQUACER 519	Oxidized HDPE wax	35	Water	Non-ionic/anionic	125	9
AQUACER 531	Modified HDPE wax	45	Water	Non-ionic	130	3.5
AQUACER 552	Oxidized HDPE wax	35	Water	Non-ionic	130	9
AQUACER 582	Modified PE wax	40	Water	Non-ionic	125	9
AQUACER 840	Oxidized HDPE wax	30	Water	Cationic	135	5
AQUACER 1031	Oxidized LDPE wax	40	Water	Non-ionic	105	7
AQUACER 1547	Oxidized HDPE wax	35	Water	Anionic	125	9.7
AQUACER 2500	Modified PE wax	40	Water	Non-ionic	125	10
AQUACER D 272	Modified PE wax	55	Water	-	125	4
AQUAMAT 208	Oxidized HDPE wax	35	Water	-	135	8.5
AQUAMAT 263	Oxidized HDPE wax	35	Water/propylene glycol n-butylether 12:1	-	130	9.5
AQUAMAT 272	Modified PE wax	55	Water	-	125	4
AQUAMAT 1400	Oxidized HDPE wax	15.7	Water	-	130	8.5
Polypropylene wax						
AQUACER 593	Modified PP wax	30	Water	Non-ionic	160	9
AQUACER 595	Modified PP wax	40	Water	Non-ionic/anionic	140	8.5
AQUACER 597	Modified PP wax	35	Water	Cationic	140	5.5
AQUACER 1041	Modified PP wax	40	Water	Cationic	140	7.5
AQUACER 1510	Modified PP wax	40	Water	Non-ionic	160	9
AQUACER 3500	Modified PP wax	41	Water	Cationic	160	7
EVA/EAA copolymer wax						
AQUACER 526	Modified EVA copolymer wax	30	Water	Anionic	105	9.7
AQUACER 527	Modified EVA copolymer wax	35	Water	Non-ionic	105	9
AQUACER 528	EAA copolymer wax	35	Water	Non-ionic	105	9.5
AQUACER 1021	Modified EVA copolymer wax	40	Water	Non-ionic/anionic	105	8.5
AQUACER 1061	EAA copolymer wax	30	Water	Anionic	110	7.5
AQUATIX 8421	Modified EVA copolymer wax	20	Water	Non-ionic	105	5.5
Montanester wax						
AQUACER 541	Montanester wax	30	Water	Non-ionic	80	4.5
Bees wax						
AQUACER 561	Bees wax	25	Water	Non-ionic	65	5.5

PE = Polyethylene HDPE = High Density Polyethylene LDPE = Low Density Polyethylene

PP = Polypropylene EVA = Ethylene-Vinylacetate EAA = Ethylene-Acrylic Acid

figure 4

Primary Polyethylene Dispersions in Water

	Polymer base	Non-volatile matter (%)	Carrier	Emulsifier system	Melting point polymer component (°C)	pH value (20 °C)
AQUACER 1040	Modified Primary PE	38	Water	Non-ionic/anionic	95	9
AQUACER 1063	Primary PE	40	Water	Non-ionic/anionic	95	9
HORDAMER PE 02	Primary PE	40	Water	Anionic	95	8-12
HORDAMER PE 03	Primary PE	40	Water	Non-ionic/anionic	95	9
HORDAMER PE 34	Modified Primary PE	38	Water	Non-ionic/anionic	95	9
HORDAMER PE 35	Primary PE	37.5	Water	Non-ionic/anionic	125	9.5

PE = Polyethylene

figure 5

Wax Dispersions in Organic Solvents

	Wax base	Non-volatile matter (%)	Carrier	Melting point wax component (°C)	Particle size Hegman (µm)	Particle size distribution (µm)	
						D50	D90
Carnauba wax							
CERACOL 79	Carnauba wax	20	Dipropyleneglycol monomethylether	85	-	2	6
CERACOL 80	Carnauba wax	17.5	Methylethylketone	85	-	2	4.5
CERACOL 604	Carnauba wax	11.5	Butylglycol	85	-	4	7
CERACOL 609 N	Wax-modified lanolin	20	Aromatic hydrocarbons/isopropanol 1:1	85	-	3	6
CERACOL 2600	Carnauba wax	17.5	Isopropanol	85	<20	-	-
CERAFAK 140 N	Carnauba wax	15	Isobutanol/aromatic hydrocarbons 13:4	90	10	-	-
Fischer-Tropsch wax							
CERACOL 83	FT wax	20	Isopropanol	105	-	2.5	6
CERAFAK 117	Modified FT wax	25	Aromatic-free white spirit	110	50	-	-
CERAFAK 127 N	Modified FT wax	15	Aromatic hydrocarbons	120	-	3	7
Polyethylene wax							
CERACOL 607	PTFE modified PE wax	35	Butyldiglycolacetate/butyldiglycol/aromatic hydrocarbons 1/1/1	115	-	4	10
CERAFAK 111	PE wax	12.5	Butylacetate	110	<12	-	-
CERAMAT 248	PE wax	20	Aromatic-free white spirit	110	20	-	-
CERAMAT 250	PE wax	40	Butylacetate	120	16	-	-
CERAMAT 258	Oxidized HDPE wax	17.5	Butylacetate	135	30	-	-
MINERPOL 220	PE wax	90	Linseed oil/mineral oil	120	25	-	-
MINERPOL 221	PE wax	>98	Linseed oil	120	30	-	-
EVA/EAA copolymer wax							
CERAFAK 100	EVA copolymer wax	10	Xylene/butylacetate 1:1	105	25	-	-
CERAFAK 103	EAA copolymer wax	6	Xylene/butylacetate/butanol 7:8:1	110	15	-	-
CERAFAK 106	EVA copolymer wax	6	Xylene/butylacetate/butanol 7:8:1	105	20	-	-
CERAFAK 110	EVA copolymer wax	6	Butylacetate/butanol 15:1	105	20	-	-
CERATIX 8461	EVA copolymer wax	4.7	Xylene/butylacetate/butanol 3:6:1	105	20	-	-
CERATIX 8463	EVA/EAA copolymer wax mixture	4.4	Xylene/butylacetate/butanol 3:6:1	110	15	-	-
CERATIX 8466	EVA copolymer wax	4.7	Butylacetate/butanol 9:1	100	20	-	-

PE = Polyethylene   HDPE = High Density Polyethylene   EVA = Ethylene-Vinylacetate

EAA = Ethylene-Acrylic Acid   FT = Fischer-Tropsch   PTFE = Polytetrafluoroethylene

figure 6

Micronized Wax Additives

	Wax base	Melting point (°C)	Density (g/ml)	Particle size distribution (µm)	
				D50	D90
Polyethylene wax					
CERAFLOUR 916	Modified HDPE wax/polymer mixture	135	0.99	46	82
CERAFLOUR 925	Modified PE wax	115	1.06	6	10
CERAFLOUR 929	Modified PE wax	115	1.06	8	15
CERAFLOUR 950	Modified HDPE wax	135	0.95	9	15
CERAFLOUR 961	Modified PE wax	140	0.95	5	11
CERAFLOUR 962	Modified PE wax	140	1.00	9	21
CERAFLOUR 968	PTFE-modified PE wax	115	1.00	6	11
CERAFLOUR 969	PTFE-modified PE wax	115	1.30	6	14
CERAFLOUR 988	Amide-modified PE wax	140	0.97	6	13
CERAFLOUR 991	PE wax	115	0.95	5	9
CERAFLOUR 996	PTFE-modified PE wax	115	0.96	6	11
CERAFLOUR 997	PTFE-modified PE wax	115	0.96	7	13
CERAFLOUR 998	PTFE-modified PE wax	115	0.96	5	9
Polypropylene wax					
CERAFLOUR 913	PP wax	160	0.90	18	31
CERAFLOUR 914	PP wax	160	0.90	24	36
CERAFLOUR 915	PP wax	160	0.90	34	57
CERAFLOUR 970	PP wax	160	0.90	9	14
Amide wax					
CERAFLOUR 960	Modified amide wax	145	1.00	4	11
CERAFLOUR 964	Amide wax	75	1.00	20	50
CERAFLOUR 993	Amide wax	145	1.00	13	31
CERAFLOUR 994	Amide wax	145	0.99	5	10
Polytetrafluoroethylene					
CERAFLOUR 965	PTFE	-	2.20	31	80
CERAFLOUR 981	PTFE	-	2.28	3	8

PE = Polyethylene HDPE = High Density Polyethylene PTFE = Polytetrafluoroethylene

PP = Polypropylene

figure 7

Micronized Polymers

	Polymer base	Melting point (°C)	Density (g/ml)	Particle size distribution (µm)	
				D50	D90
CERAFLOUR 917	Organic polymer	135	0.93	42	64
CERAFLOUR 920	Organic polymer	-	1.47	5	13
CERAFLOUR 967	Synthetic polymer	-	1.11	-	-
CERAFLOUR 1000	Organic polymer	175	1.25	5	13

figure 8

For more information about our additives and instruments, as well as our additive sample orders please visit:

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