

PROCESS OILS FOR RUBBER – ITS SELECTION CRITERIA

Process oils play the biggest Quantitative role in designing the Rubber compounds. The influence of the process oils are:

- Improvement in the flow of the rubber compounds & energy savings during the processing of rubber – especially reduced energy peaks during processing.
- Improved filler dispersion in the rubber compound.
- Improvement in processing & tackiness of the rubber compound.
- Also helps in lowering the Tg of the rubber compound, elevating electrical conductivity, increasing the flame protection.

PROCESS OIL IS GENERALLY CLASSIFIED AS

Mineral Oils

Natural Products

Synthetic Plasticisers

Further it is classified based on the group

Mineral oil plasticizers

- Mineral oils: paraffinic, relatively naphthenic, naphthenic, relatively aromatic, aromatic, highly aromatic, extremely aromatic
- Paraffines and ceresin
- Coumarone and indene resins
- Petroleum distillation residues

Fatty acids, fatty acid derivatives, process aids

- Fatty acids
- Metallic soaps
- Fatty acids esters and fatty alcohols
- Pentaerythritol tetrastearate
- Emulsion plasticizers
- Polyethyleneglycol fatty alcohol ethers

Animal and vegetable fats, Oil and resins

- Raw wool fat (Landin)
- Fat emulsions
- Vegetable oils (palmoil, soybean oil)
- Resins (pine tars)

Synthetic plasticizers

- Ether plasticizers
- Dibenzylether
- Polyether and polyether-thioethers
- Thioether-esters

Ester plasticizers

- Phthalic acid esters
- Adipic acid and sebacic acid esters
- Trimalleates
- Phosphoric acid esters

In Mineral oils, a further classification is based on the determination of the viscosity-density constant (VDK), using the formula

$$\text{VDK} = \{1196 - \text{Aniline point(in } ^\circ\text{F)}\}/1170$$

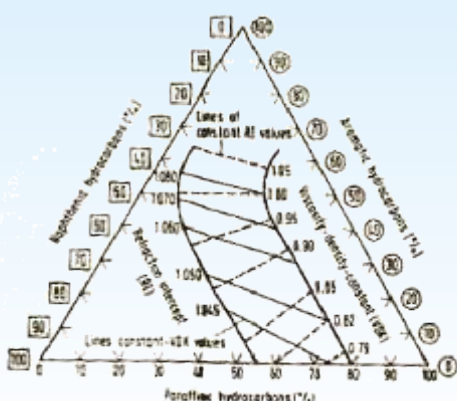
The VDK number allows an estimate of the properties of the mineral oil.

RELATION BETWEEN VDK & COMPOSITION OF MINERAL OILS

TYPE OF MINERAL OIL	RANGE OF VDK
PARAFFINIC	0.791 – 0.820
RELATIVELY NAPHTHENIC	0.821 – 0.850
NAPHTHENIC	0.851 – 0.900
RELATIVELY AROMATIC	0.901 – 0.950
AROMATIC	0.951 – 1.000
HIGHLY AROMATIC	1.001 – 1.050
EXTREMELY AROMATIC	➤ 1.050

CORRELATION BETWEEN REFRACTION INTERCEPT (RI) & COMPOSITION OF MINERAL OILS

TYPE OF MINERAL OIL	RI RANGE
PARAFFINIC	< 1.048
NAPHTHENIC	1.048 – 1.065
AROMATIC	1.053 – 1.065
HIGHLY AROMATIC	➤ 1.065



In the diagram, by knowing VDK & RI an accurate determination of the composition of the mineral oil is possible by carbon-distribution analysis.

For example if RI = 1.05 & VDK = 0.90, then from the below diagram, this oil will have 35% paraffinic, 40% naphthenic & 25% aromatic components.

THE SELECTION GUIDE FOR PARAFFINIC , NAPHTHENIC & AROMATIC OIL IS AS FOLLOWS

RAJPROL® P Paraffinic Process Oils										
	Test Description	Test Method (ASTM)	Specification Limits							
			P1	P40	P60	P80	P100	P250	460 M	P500
Typical Properties	Appearance	Visual	Bright & Clear							
	Colour	D1500	2 Max	0.5 Max	2 Max	1 Max	1 Max	5.5 Max	4 Max	5.5 Max
	Density @ 15.6°C, g/ml	D1298	0.85-0.88	0.84-0.89	0.87-0.89	0.86-0.90	0.86-0.90	0.90-0.94	0.88-0.91	0.89-0.92
	Kin. Viscosity @ 40°C, cSt	D 445	29-35	38-51	60-80	85-104	105-125	240-260	414-506	440-480
	Aniline Point C	D 611	90-104	>100	>100	100-125	100-130	105-115	>100	>120
	Flash Point°C, min	D 92	200	200	200	220	230	255	250	280
	Pour Point,°C, max	D 97	0	0	0	0	0	-6	-3	-3
	VGC (Typ)	D 2501	0.81	0.79	0.81	0.79	0.79	0.83	0.80	0.80
	Volatility, 1 hrs @ 150C, %	D 972	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
	Sulphur %, Max	D 129	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
	Carbon Type Analysis, %	IR method IS 13155 - 1991								
	C _P		>50	>50	>55	58-65	60-70	42-45	65-70	65-70
	C _N		35-40	25-40	40-50	35-40	30-40	40-42	20-28	20-28
	C _A		7-12	8-12	Nil	Nil	Nil	16-18	6-9	8-12

RAJPROL® Aromatic and Naphthenic type Process Oils										
	Test Description	Test Method (ASTM)	Specification Limits							
			Aromatic Type				Naphthenic Type			
			A1L	A1	A1H	A1G	N1	N2		
Typical Properties	Appearance	Visual	Green Viscous Liquid				Bright & Clear			
	Colour	D1500	---	---	---	---	1 Max	3 Max		
	Density @ 15.6°C, g/ml	D1298	0.98-1.05	0.98-1.05	0.98-1.05	0.98-1.05	0.85-0.88	0.87-0.89		
	Kin. Viscosity @ 40°C, cSt	D 445	---	---	---	---	8-12	18-25		
	Kin. Viscosity @ 100°C, cSt	D 445	10-22	20-25	26-40	25-50	---	---		
	Aniline Point C	D 611	25-45	40-52	30-50	30-50	72-82	70-80		
	Flash Point°C, min	D 92	220	220	220	220	145	160		
	Pour Point,°C, max	D 97	+18	+18	+18	+18	-15	-15		
	VGC (Typ)	D 2501	---	---	---	---	0.82	0.84		
	Volatility, 5 hrs @ 175C, %		---	---	---	---	< 1	< 1		
	Sulphur %, Max	D 129	5	5	5	5	< 1	< 1		
	Clay Gel Analysis, %	ASTM D 2007								
	Polar Compounds		1-2	10	1-2	1-2	---	---		
	Aromatics		78-80	73	78-80	78-80	---	---		
	Saturates		18-20	16-17	18-20	18-20	---	---		
	Carbon Type Analysis, %	IR method IS 13155- 1991								
C _P	---		---	---	---	51-60%	45-50%			
C _N	---		---	---	---	30-35%	30-35%			
C _A	---		---	---	---	15-20%	20-25%			

Above data is indicative of recent average Values only. Minor variations, which do not affect product performance or quality, may be expected in manufacture
Specific requirements (e.g. Custom viscosities) are custom made on request

RAJOL® WP - Specialty Liquid Paraffin / White Mineral Oils

Description: RAJOL® WP Oils are severely refined hydro-cracked / hydro-treated oils with highest degree of purity and are stabilized with suitable additives for oxidation/UV stability. These oils are suitable for Pharmaceutical, Cosmetic and Food industries, for direct & indirect food contact

	Test Description	Test Method	Specification Limits			
			WP 200	WP 300	WP 350	WP 500
Typical Properties & Characteristics	Appearance	Visual	Transparent clear, colourless, oily, odourless liquid free from fluorescence in daylight & suspended impurities			
	Colour, Saybolt	ASTM D 156	+ 30			
	Weight per ml @ 25 °C, gm/ml	IP	0.835 - 0.850	0.845 - 0.865	0.848 - 0.868	0.850 - 0.870
	Relative Density @ 20 °C	BP / Ph. Eur	0.840 - 0.855	0.850 - 0.870	0.853 - 0.873	0.855 - 0.875
	Relative Density @ 25 °C	USP	0.838 - 0.853	0.848 - 0.868	0.852 - 0.872	0.854 - 0.874
	Kin. Viscosity @ 40 °C, cSt	ASTM D 445	35 - 42	58 - 66	65 - 75	85 - 100
	Dy Viscosity @ 20 °C, mPas	BP / IP	85 - 110	140 - 170	165 - 210	220 - 280
	Flash Point °C, min	ASTM D 92	196 ^o	200 ^o	200 ^o	220 ^o
	Pour Point, °C, max	ASTM D 97	-9 ^o	-9 ^o	-9 ^o	-6 ^o
	Solubility	BP/Ph. Eur /IP	Passes			
	Readily Carbonisable Substance	USP/ BP/Ph. Eur	Passes			
	Solid Paraffins	/IP	Passes			
	Acidity / Alkalinity	BP/Ph. Eur /IP	Passes			
	Neutrality	USP	Passes			
	Sulphur Compounds	IP	Passes			
	Poly nuclear compounds / Polycyclic Aromatic Hydrocarbons	USP/BP/Ph. Eur/ IP & US FDA 21 CFR	Passes			
	Conforms to USFDA 21 CFR 172.878 & 178.3620(a)	US FDA	✓	✓	✓	✓
	Conforms to USP	USP	× (Density lower than USP limit)	✓	✓	✓
Conforms to BP / Ph. Eur	BP / Ph.Eur	× (Viscosity lower per BP limit)	✓	✓	× (Viscosity higher per BP limit)	
NSF Registered		×	×	✓	✓	

The above data is indicative of recent average Values only. Minor variations, which do not affect product performance or quality, may be expected in manufacture. In case of conformance to Indian Pharmacopoeia, density shall be suitably offered to meet IP requirements. Specific requirements (e.g. Custom viscosities, oils without additives, etc) will be custom-made on request.

LOW PCA OILS

Special Grade Process Oils: Produced blending of judiciously selected base stocks resulting in oils of specific characteristics. These series of oils are guaranteed to meet the European Union Directive 2005/69/EC of 76/769/EEC, for PAH content and IP346 requirements for PCA content. Some of Special grade oils are formulated to offer replacements for certain Aromatic.

RAJPROL[®] Special Grades

	Test Description	Test Method (ASTM)	Specification Limits					
			P1/E	460 P/E	N2/E	P 1500/E2	P3500/E	P3700/E
Typical Properties	Appearance	Visual	Bright & Clear				Dark Liquid	
	Colour	D1500	0.5 Max	4 Max	1 Max	4.5 Max	> 8.0	> 8.0
	Density @ 15.6°C, g/ml	D1298	0.85–0.88	0.89–0.92	0.86–0.89	0.91-0.94	0.941(T)	0.938(T)
	Kin. Viscosity @ 40°C, cSt	D 445	29–33	440–480	18–25	365–405	630–770	640–780
	Kin. Viscosity @ 100°C, cSt	D 445	---	29–33	---	17–22	---	---
	Aniline Point C	D 611	>101	>100	70–75	100 (Typ)	70–85	85–100
	Flash Point°C, min	D 92	190	240	180	230	210	250
	Pour Point°C, max	D 97	0	-3	-15	-6	-9	-9
	VGC (Typ)	D 2501	0.80	1.0	0.81	0.84	---	---
	Volatility, 5 hrs @ 175 C, %		< 1	< 1	< 1	< 1	< 1	< 1
	Sulphur %, Max	D 129	< 1	< 1	< 1	< 1	< 1	< 1
	Carbon Type Analysis, %	IR method IS 13155–1991						
	C _P		55–60%	65–70%	45–50%	42–58%	45–50%	40–47%
	C _N		25–30%	20–28%	12–25%	25–40%	10–20%	30–40%
	C _A		13–18%	6–9%	25–40%	15–20%	35–45%	15–25%
	PCA / DMSO extractible %	IP346	< 3	< 3	< 3	< 3	< 3	< 3
Sum of 8 listed PAH, EU, ppm	EU 76/769/EEC	< 10	< 10	< 10	< 10	< 10	< 10	

Above data is indicative of recent average Values only. Minor variations, which do not affect product performance or quality, may be expected in manufacture.
Specific requirements (e.g. Custom viscosities) are custom made on request

TABULATION FOR PROPERTIES OF DIFFERENT PLASTICISERS

PROPERTIES OF PLASTICIZERS, SOFTENERS PROCESSING AIDS

PROPERTIES	IMPROVED TUBING	BETTER TACK	INCREASED PLASTICITY	LOW MODULUS	INCREASED TENSILE	SOFTER ELONGATION	HARDER CURED STOCKS	HIGHER CURED STOCKS	BETTER REBOUND	LOW HYSTERESIS	HIGH HYSTERESIS	IMPROVED FLEX LIFE	IMPROVED PROCESSING	MOULD DISPERSION	FLAME RETARDANT
PETROLEUM PRODUCTS PROPERTIES															
UNSATURATED															
MINERAL OILS															
UNSATURATED ASPHALT															
ASPHALTS OTHERS															
VEGETABLE OILS PROPERTIES															
GELLED OILS (SULFONATED)															
SOLID SOYA															
TALL OIL															
SOYA POLYESTER															
COAL TAR PRODUCTS PROPERTIES															
COAL-TAR PITCH															
SOFT CUMARS-TRAS															
SOFT-COAL TAR															
CUMAR RESINS															
PINE PRODUCTS PROPERTIES															
CRUDE GUM TURPENTINE															
ROSIN OIL															
ROSIN															
PINE TAR															
DIPENTENE															
CERTAIN ROSINS															
ROSIN ESTER															
ESTERS PROPERTIES															
DICAPRYL PHTHALATE															
BUTYL CUMINATE															
DIBUTYL PHTHALATE															
BUTYL LACTATE															
GLYCEROL															
CHLOROBENZOATE															
CHLORODIBUTYL CARBONATE															
METHYL RICINOLEATE															
BUTYL OLEATE															
DIBUTYL SEBACATE															
DIOCTYL PHTHALATE															
METHYL OLEATE															
TRICRESYL PHOSPHATE															

Please Note: All the grades of oil shown here is manufactured by M/s.RAJ PETRO SPECIALITIES PVT. LTD., CHENNAI.