Properties of Some Common Polymer Coatings[3]

Butyl rubber (isobutene-isoprene copolymers) Good resistance to heat aging, oxidation, UV light, ozone, and general chemical attack. Low permeability to gases. Servicable temperature range −50 to +125°C. Difficult to seam. Low to moderate cost.

Hypalon (chlorosulfonated polyethylene) Similar to neoprene. Relatively poor low temperature resistance. Moderate cost.

Natural rubber (polyisoprene) Good tensile strength and flexibility. Tear strength and abrasion resistance improved by reinforcing fillers (e.g., carbon black). Insoluble in all organic liquids when vulcanized, but highly swollen by hydrocarbons and chlorinated solvents. Unaffected by dilute acids, alkalis, and water. Susceptible to oxidation; less so to ozone. Contains 2–4% of protein, which enhances susceptibility to biodegradation. Servicable temperature range −55 to +70°C. Sewn or glued seams required. Moderate cost.

Neoprene (polychloroprene) Good mechanical properties. Resistant to most chemicals and organic liquids; swollen by chlorinated and aromatic solvents. Excellent weathering properties. Inferior low temperature properties to those of natural rubber. Upper temperature limit about 120°C. Low to moderate cost.

Nitrile rubber (acrylonitrile-butadiene copolymers) Similar to natural rubber except for improved resistance to swelling in organic liquids and improved resistance to heat, light, and oxidative aging. Moderate cost.

PTFE (polytetrafluoroethylene) Exceptional resistance to chemicals, solvents, heat, oxidation, weathering, and microorganisms. Excellent electrical and nonstick properties. Difficult to seam. Serviceable temperature range −70 to +250°C. Very high cost.

PU (polyurethanes) Very variable compositions; properties range from hard, inflexible plastics to soft, elastic coatings. Plasticizers not required. Some grades have good resistance to fuels and oils. Excellent strength and resistance to tearing and abrasion. Thermoplastic grades available. Moderate to high cost.

[3]Adapted with permission from G. R. Lomax Textiles, vol. 14, no. 2. 1985 © Shirley Institute, U.K.

PVC (polyvinyl chloride) Naturally rigid material; requires careful formulating to produce durable, flexible coatings. High plasticizer content (up to 40% by weight). Good chemical properties, although solvents tend to extract plasticizers and stiffen the polymer. Good weathering properties and flame resistance. Poor low temperature performance, unless special plasticizers are used. Thermoplastic and can therefore be seamed by hot air, radio-frequency, and ultrasonic welding techniques. Low cost.

PVDC (polyvinylidene chloride) Similar to PVC. Better flame resistance. Low permeability to gases. Low to moderate cost.

SBR (styrene butadiene rubber) Similar to natural rubber except for improved flex and abrasion resistance, particularly under hot, dry conditions. Inferior tear resistance and serviceable temperature range. Resistant to biodegradation. Moderate cost.

Silicone rubbers (polysiloxanes) Inferior mechanical properties to normal rubbers. Resistant to most chemicals except concentrated acids and alkalis. Resistant to oxidation, aging, and microorgansims. Relatively high permeability to gases. Serviceable temperature range -60 to 200°C. Tasteless, odorless, and physiologically inert. Difficult to seam. High cost.

Typical Formulation of Coating Compounds

COMPOSITE COATING FOR UPHOLSTERY FABRIC[4]

BASE COAT

PVC polymer: (E, K value 68–70)	100
Stabilizer: liquid, Ca/Zn containing (e.g., Irgastab CZ 57)	1.5–3.0 phr
Costabilizer: epoxidized soya bean oil	6.0–8.0 phr
Plasticizer: DOP	85 phr
Filler: whiting	20 phr

INTERMEDIATE (EXPANDED) COAT

PVC polymer (E, K value 68–70)	100
Stabilizer/activator: liquid, Zn containing (e.g., Irgastab ABC2)	1.5–2.5 phr
Costabilizer: epoxidized soya bean oil	6.0–8.0 phr
Plasticizers: DOP	45 phr
BBP	30 phr
Blowing agent: azo dicarbonamide (paste 1:1in DOP)	2.5–4.5 phr
Filler: whiting	5 phr

TOP COAT

PVC polymer (E, K value 70–72)	100
Stabilizer: liquid Ba/Cd/Zn Complex (e.g., Irgastab BC 206)	1.5–2.5 phr
Costabilizer: epoxidized soya bean oil	5.0 phr
Plasticizer: DOP	52 phr

[4]Reproduced with permission from *PVC Plastics* by W. V. Titow. © Kluwer Academic Publishers, the Netherlands.

Pigment: TiO_2	0.0–3.0 phr
Filler: whiting	0.0–10.0 phr
Colorant:	as required

POLYCHLOROPRENE COMPOUND FOR FLOATS, RAFTS, ETC.—FABRIC POLYAMIDE (Courtesy India Waterproofing and Dyeing Works, 13 Brabourne Road, Calcutta, India)

(1) Bayprene 110	100.0 (polychloroprene rubber) Bayer
(2) Magnesia	4.0
(3) Stearic acid	0.5
(4) MBTS	1.0 (dibenzthiazyl disulfide)
(5) Nonox DN	1.5 (phenyl-β-naphthyl amine)
(6) Accinox 4010 NA	0.5 (*N*-isopropyl N-phenyl-*p*-phenylene diamine)
(7) FEF black	25.0 (fine extrusion furnace black)
(8) Silica	20.0
(9) DBP	8.0 (dibutyl phthalate)
(10) Zinc oxide	5.0
(11) NA 22	0.75 (ethylene thiourea)

RUBBER COMPOUND FOR POTABLE WATER TANKS—FABRIC POLYAMIDE (Courtesy India Waterproofing and Dyeing Works, 13 Brabourne Road, Calcutta, India)

(1) Hypalon 45	100.0 (chloro sulfonated polyethylene) Dupont
(2) China clay	100.0
(3) Magnesia extra light	2.0
(4) SRF black	0.5 (semi-reinforcing furnace black)

BUTYL RUBBER COMPOUND FOR IMPERMEABLE FLAME RETARDANT PROTECTIVE CLOTHING—FABRIC POLYAMIDE (Courtesy DMSRDE, Kanpur, India)

(1) BIIR	100.0 (bromobutyl rubber 2244—Polysar)
(2) CR	20.0 (neoprene WM1—Dupont)
(3) Chlorinated paraffin wax	5.0 (58% chlorine content)
(4) Stearic acid	1.0
(5) PBN	1.0 (phenyl-β-naphthyl amine)
(6) Zinc oxide	10.0

(7) Antimony oxide	10.0
(8) Saytax	20.0 (decabromo diphenyl ether)
(9) Chlorinated polyethylene	5.0
(10) Magnesium oxide	4.0
(11) Sulfur	1.5
(12) TMTD	1.5 (tetramethyl thiuram disulfide)
(13) MBTS	1.5 (dibenzyl thiazyl disulfide)
(14) ZDC	0.5 (zinc diethyl dithiocarbamate)

POLYURETHANE FORMULATION FOR TRANSFER COATING (Courtesy M/S Entremonde Polycoater Ltd., Mumbai, India)

Solution A top coat	Impranil C granules 1.0
	Methyl ethyl ketone 2.5
Solution B tie coat	5% Imprafix TH in solution A

Impranil C, an aromatic polyester polyurethane (Bayer)
Imprafix TH, a cross-linking agent (Bayer)

ALIPHATIC POLYURETHANE FORMULATION FOR DIRECT COATING OF TOP COAT (Courtesy M/S Entremonde Polycoater Ltd., Mumbai, India)

SU 5001	1.0
Isopropyl alcohol + toluene (1:1)	0.5
Pigments if required	as desired

SU5001 is an aliphatic polyester polyurethane of Stahl GB U.K

TYPICAL THERMOPLASTIC POLYURETHANES FOR HOT-MELT COATING (Courtesy M/S Entremonde Polycoater Ltd., Mumbai, India)

a. BF Goodrich 54630 (polyether)
b. BF Goodrich 54620 (polyester)
Resins can be pigmented if necessary