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List of Encouraged Substitutes to Toxic and Hazardous Raw Materials (Products) (2012)

	Substitutes	Chemicals to be substituted	Application
Type 1. Developing class			
(1) Substitution of heavy metals			
1	Trivalent chromium-based passivating solution	High-concentration hexavalent chromium based passivating solution	Passivation of zinc plating
2	Boron nitride	Beryllium oxide	Microwave tubes and high power microwave vacuum devices
3	Low-mercury catalyst (mercuric chloride content lower than 4%) or mercury-free catalyst	Mercury catalyst (mercuric chloride content between 10 and 12.5%)	Synthesis of vinyl chloride from acetylene
(2) Substitution of organic pollutants			
4	Biodegradable water-based ink	organic solvent-based ink	Printing and packaging
5	Aqueous gravure ink	Organic solvent-based gravure ink	Gravure printing in food, pharmaceuticals and plastic packaging
6	Perfluoropolyethers emulsifier	Perfluorooctanoic acid and its nitrates	Synthesis of the fluorine-containing resin
7	Polyunsaturated fatty acid derivatives as surfactants	APEO surfactant	consumer goods and textile industries
8	Fatty alcohol polyoxyethylene ether(FAO)	APEO surfactant	consumer goods and textile industries
9	N-alkyl glucamide(AGA)	APEO surfactant	consumer goods and textile industries
10	alkyl polysaccharide glycoside (APG)	APEO surfactant	consumer goods and textile industries
11	PAHs-free aromatic oil	Aromatic oil	Rubber products

	Substitutes	Chemicals to be substituted	Application
12	Perfluorobutyl water-, oil-, and stain-repellent fabric finishes	PFOS	Textiles
Type II, Applied class			
(1) Substitution of heavy metals			
13	calcium phosphite anti-corrosion pigment	Lead, chromium and zinc-containing anti-corrosion pigments	Anti-corrosion coatings
14	Trivalent chromium-based plating solution	Hexavalent chromium-based plating solution	Automobiles, electronics, mechanics, machinery
15	Zinc-nickel alloy coating	Cadmium plating	Ship manufacturing
16	Antimony Trioxide Equivalent environment-friendly flame retardant	Antimony Trioxide	Polymer flame retardant formulations
17	New lead-acid battery, such as lead-calcium alloy battery	Lead cadmium batteries	The field of lead-acid battery applications
18	Chromium-free firebricks	High chromium bricks	High-temperature kilns in cement, steel, non-ferrous industries
19	Stannous oxide	Arsenic oxide	optoelectronics displays, glass production
(2) Substitution of organic pollutants			
20	APEO-free architectural coatings and emulsions	Architectural coatings and emulsions containing APEO	Interior and exterior architectural coatings
21	Water-based wood finishes	Organic solvent-based water finishes	Wood finishing, home decoration
22	Metal surface silane treatment agent	Phosphating solutions	Metal surface coatings in automobile, home appliance, and machine manufacturing industries
23	Halogen-free flame retardant agents for polypropylene	Polybrominated Biphenyl(PBB) & Polybrominated Biphenyl ether(PBDE)	Flame retardants for polyolefin
24	Wood wax and wood	Polyurethane varnish	Interior decoration

	Substitutes	Chemicals to be substituted	Application
	lacquer		
25	Water-based wood lacquer for interior uses	Polyurethane varnish	Interior decoration
26	Casein glue	Polyvinyl acetate (PVAc) emulsion	Industrial adhesives
27	Benzene-free glue	Neoprene glue	Industrial adhesives
28	Water-soluble melamine glue	Urea-formaldehyde glue, phenol-formaldehyde glue	Wood glue
29	Glyoxal urea-formaldehyde glue	Urea-formaldehyde glue	Man-made board manufacturing
30	Formaldehyde-free adhesive	Urea-formaldehyde glue	Man-made board manufacturing
31	High activity lignin	Phenol	Phenolic materials
32	Waterborne polyurethane adhesive	Solvent-based polyurethane adhesive	Adhesives
33	water-based polyurethane resin	Solvent-based polyurethane resin	Leather processing and synthetic leather manufacturing
(3) Substitution of pesticides			
34	White oil	Toluene, xylene solvents	Emulsifiable concentrates processing
35	Turpentine-based oil solvent	Toluene, xylene solvents	Emulsifiable concentrates processing
(4) Substitution of other toxic and hazardous matters			
36	Raw materials for enzymatic synthesis of amoxicillin	Raw materials for chemical synthesis of amoxicillin	Amoxicillin production
37	Cyanide-free, formaldehyde-free acid copper plating liquid	Cyanide-containing copper plating liquid	Copper strike of steel and iron parts
38	Fluorine-free mold release oil repellent	Fluorinated oil repellent	Industrial mold release processing
Type III: Established class			
(1) Substitution of heavy metals			
39	Tungsten-containing alloy coatings	Chrome coating	Oil exploration and drilling
40	black sulfate trivalent chromium plating solution with high-coverage capacity	Hexavalent chromium plating solution	Military industry

	Substitutes	Chemicals to be substituted	Application
41	Chrome-free passivating agent	Potassium dichromate	Passivation of zinc plating
42	Lead-free electronic paste	Lead-containing electronic paste	Hybrid circuits, thermistors, solar cells
43	Lithium-ion battery	Lead-acid battery	Electric bicycles, electric tools
44	Colloidal tube type lead-acid battery	Open type, rich fluid tube type lead-acid battery	Standby power supply, energy storage system
45	Mercury-free alkaline manganese button batteries	Mercury-containing alkaline manganese button batteries	Battery production
46	NiMH batteries	Nickel-cadmium batteries	Batteries for power tools, portable electric appliances
47	Auxiliary agent for recycling of chrome-tanned waste	Trivalent chrome tanning agent	Leather processing
48	calcium/zinc stabiliser	Lead salt stabilizer	PVC products
49	Rare earth stabilizer	Lead salt stabilizer	PVC products
50	Mercury catalyst (mercuric chloride content between 4 and 6.5%)	Mercury catalyst (mercuric chloride content between 10 and 12.5%)	Synthesis of vinyl chloride from acetylene
(2) Substitution of organic pollutants			
51	Highly stain-resistant waterborne architectural coatings	Organic solvent-based architectural coatings	Interior and exterior architectural coatings
52	Aqueous highly elastic waterproof coating	Solvent-based water-resistant coatings, such as polyurethane	Waterproofing for architecture and reinforced concrete
53	Waterborne epoxy resin coatings	Solvent-based epoxy resin coatings	Main film-forming matter in anti-corrosion coatings
54	Waterborne plastic coatings	Solvent-based plastic coatings	Coatings for plastic products
55	Ultraviolet (UV) curable coatings	Organic solvent-based coatings	Powder coatings for wooden furniture, plastics, paper products, automobiles
56	Waterborne industrial coatings	Organic solvent-based industrial coatings	Coatings for industrial products

	Substitutes	Chemicals to be substituted	Application
57	Waterborne polyurethane, acrylic resin	Organic solvent-based resin	Coatings, adhesives, dyes and ink pigments
58	Ester solvents	Xylenes solvents	Paint solvents, paint thinners, Pesticide solvents and metal cleaners
59	Waterborne alkyd resin	Solvent-based alkyd resin	Coatings
60	Alcohol-type and ester-type benzene-free and ketone-free ink	Solvent-based ink containing benzene and ketone	Printing on plastic films and composite materials
61	Ultraviolet (UV) curable ink	Solvent-based ink	Printing and packaging
62	Solvent-free polyurethane adhesives	Solvent-based polyurethane adhesives	Packaging for food and consumer goods
63	Hydrotalcite	brominated flame retardants, Lead stearate	Polymer flame retardant
64	Wood-plastic composites	Wooden man-made board	Interior and exterior construction
65	Strawboard	Formaldehyde-containing man-made board	Furniture, building, decoration, and packaging materials
66	Chlorine dioxide	Liquid chlorine	Paper industry
67	Citric acid ester plasticizers	Phthalate plasticizers	Medical equipment, food packaging, children's toys
68	Synthetic leather water-based colorant	Solvent-based colorant	Synthetic leather dyeing
(3) Substitution of pesticides			
69	plant-based synergist	Chemically synthetic synergist	Foliar spraying pesticides
70	C23-29 alkanes solvents	Toluene, xylene solvents	Emulsifiable concentrates processing and emulsion-in-water processing for pesticides
71	Petroleum ether	Xylene	Production of acetochlor using methylene method
72	Pirimiphos-methyl	Aluminum phosphide	Grain storage pest control
73	Insect virus pesticides	Highly toxic pesticides	Lepidopteran pest

	Substitutes	Chemicals to be substituted	Application
			control
74	Lo-Wei (TDS)	Sodium pentachlorophenate	Schistosomiasis prevention
75	Niclosamide	Sodium pentachlorophenate	Schistosomiasis prevention
76	Metaldehyde	Sodium pentachlorophenate	Schistosomiasis prevention
(4) Substitution of other toxic and hazardous matters			
77	β -hydroxyalkylamide curing agent	Triglycidyl isocyanurate	Curing agent in weather-resistant powder coatings
78	Potassium dihydrogen citrate (malononitrile alloy (I))	Potassium aurocyanide	Gold plating
79	Rubber vulcanization accelerator ZBDC	Rubber vulcanization accelerator PZ	Rubber products
80	Rubber vulcanization accelerator	Rubber vulcanization accelerator TMTD	Rubber products
81	High-tenacity high-modulus polyvinyl alcohol (PVA) fibre	Asbestos	Cement components and interior decoration materials

- The “developing class”, referring to the non-toxic, non-hazardous or low-toxic, low-hazardous alternatives that requires an urgent research and development;
- The “applied class”, referring to the promising non-toxic, non-hazardous or low-toxic, low-hazardous alternatives that are available but yet to be commercialized;
- The “established class”, referring to the mature alternatives that need greater distribution and utility in the future;