

Testing of Paint Reformulation Guidelines and the Reformulation Results

NCPC China

Chinese Research Academy of Environmental Sciences(CRAES)



The Feedback on the Guidelines

- For the partners that reviewed the Guidelines:
 - Solid Waste and Chemicals Management Center, Ministry of Ecology and Environment(MEE)
 - Ministry of Industry and Information Technology(MIIT)
 - Chinese Research Academy of Environmental Sciences(CRAES)
 - China National Coating Industry Association(CNCIA)
 - SMEs
- What was their opinion?
 - The guidelines would be a useful tool for the SMEs that may not have access to technical experts or information for reformulation.
- What do they think: if have read the Guidelines, what should be i.e. added , be better explained....
 - Driers and additives have almost been replaced in years ago, more technical options for pigment alternatives for reformulation are welcomed
 - Economic reason is one of the most important issue for the reformulation, especially for SMEs to afford

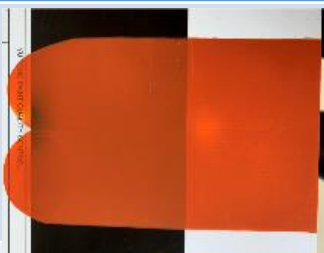

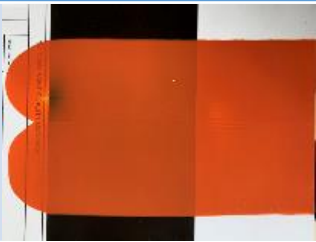


Reformulation overview in China

No	SMEs selected	Stages of paint reformulation	Type of products reformulated	Use	The quantity of production of selected lead paint	The type and the quantity of lead-containing raw materials
1	Zhejiang Utop New Material Co.,Ltd	S7 - Reformulation process in the lab finished	Alkyd paint(only alkyd products of this company contain lead. It can be completely replaced if the plan would work)	Anticorrosion	2012 t/year (2019)	Lead-containing pigment 73 t/year (2018)
2	Zhejiang Tiannu Group Paint Co., Ltd	S7 - Reformulation process in the lab finished	Epoxy paint-green and grey	Industrial-flooring use	860 t/year (2019)	517 t/year (2019)
3	Hunan Xiang Jiang Paint Group Co.,Ltd	S7 - Reformulation process in the lab finished	Acrylic polyurethane paint-green	Industrial	830 t/year (2019)	207 t/year (2019)
4	Jiangsu Lanling Polymer Material Co., Ltd	S7 - Reformulation process in the lab finished	Acrylic polyurethane	Industrial	1000 t/year (2019)	30 t/year (2019)
5	Jiangsu Changjiang Paint Co., Ltd	S7 - Reformulation process in the lab finished	Acrylic polyurethane topcoat-yellow	Commercial vehicles	450 t/year (2019)	307.97 t/year (2019)

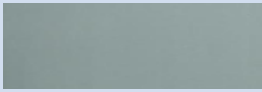



Reformulation Results of Selected Products


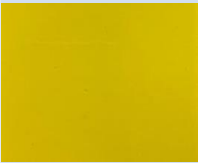
RESULTS OF PARALEL LAB TESTINGS –Company 1			
Request	Lead paint (Red lead)	Paint free of lead (Iron Oxide Red)	Paint free of lead (Iron titanium powder)
Colour			
Particle size (µm)	≤60µm	≤60µm	≤60µm
Drying time	Surface 10min Curing 6h	Surface 10min Curing 6h	Surface 10min Curing 6h
Salt spray (300 h)	300 h	300 h	300h
Adhesion	2	2	2
Hardness	HB	HB	HB





Reformulation Results of Selected Products

RESULTS OF PARALEL LAB TESTINGS –Company 2		
Request	Lead paint	Paint free of lead
Colour		
Drying time	Surface 2h, Internal 10h	Surface 2h, Internal 10h
Pencil hardness(scratch)	2H	2H
Impact resistance/cm	50	50
Flexibility/mm	2	2
Cross-cut test/level	1	1
Abrasion resistance (750g/500 r)/g	0.042	0.050
Water resistance (168h)	No blistering, no falling off, first grade discoloration	No blistering, no falling off, first grade discoloration
Oil resistance (120# gasoline 168h)	No blistering, no falling off, first grade discoloration	No blistering, no falling off, first grade discoloration
Acid resistance (10% H_2SO_4 , 168h)	No blistering, no falling off, first grade discoloration	No blistering, no falling off, first grade discoloration
Alkali resistance (10%NaOH, 168h)	No blistering, no falling off, first grade discoloration	No blistering, no falling off, first grade discoloration



4.3 RESULTS OF PARALEL LAB TESTINGS-Company 3

Request	Lead Paint	Paint free of lead
Colour		
Colour difference	ΔE≤0.5	ΔE≤0.5
Gloss	89.6%	91.5%
Freshness	85%	86%
Construction	55g/m ²	60g/m ²
Adhesion (cross-cut method)	Grade 1	Grade 1
Pencil hardness (scratch)	H	H
Impact strength (positive impact)	50kg•cm	50kg•cm
Flexibility	1mm	1mm
Resistance to xenon lamp aging, 500h	Meet requirements	Meet requirements
Resistance to xenon lamp aging, 1000h	Does not meet the requirements	Meet requirements
Resistance to xenon lamp aging, 2000h	Does not meet the requirements	Meet requirements

4.3 RESULTS OF PARALEL LAB TESTINGS-Company 4

Request	Lead Paint	Paint free of lead
Colour		
Colour difference	△E2.1	△E2.25
Coverage	120 g/m ²	135g/m ²
Drying time	Surface dry: 10min Internal dry: 24h	Surface dry: 10min Internal dry: 24h
Salt spray	1000 h, grade 1	1000 h, grade 1
Adhesion	Grade 1	Grade 1
Acid resistance(5 % H2SO4 solution),7d	severely discoloured, no blistering, no falling off	no change of colour, no blistering, no falling off
Alkali resistance(5 % NaOH solution),7d	no change of colour, no blistering, no falling off	no change of colour, no blistering, no falling off
Hardness	H	H
Artificial aging	500 h Discoloration level 2,loss of light level 3 No rust, no blistering, no chalking	1000 h Discoloration level 1,loss of light level 1 No rust, no blistering, no chalking

4.3 RESULTS OF PARALEL LAB TESTINGS-Company 5

Request	Lead Paint	Paint free of lead
Colour	 含铅黄色丙烯酸聚氨酯面漆	 不含铅黄色丙烯酸聚氨酯面漆
Fitness/μm	≤20	≤20
Surface drying time/h	≤2	≤2
Internal drying time /h	≤24	≤24
Bending test/mm	2	2
Impact resistance/cm	50	50
Salt spray resistance/h	1000	1000
Adhesion/Mpa	≥4	≥4
Acid resistance (50g/L H ₂ SO ₄) /h	168	168
Alkali resistance (20g/L NaOH) /h	168	168
Weathering resistance/h	1000	1000



Drivers and barriers to SMEs reformulation

Drivers

- **Government control and regulation of lead paint**
China government has formulated and issued a series of policies and regulations to limit the production and use of lead. Particularly in 2020, China has issued 4 national standards on the control of lead paint with total lead rather than soluble lead, **90 ppm** for woodware and architectural wall coating.
- **Industrial cooperation**
Work closely with CNCIA to organize workshops or aware raising activities to promote the project.
- **SMEs awareness raising**
With increasing environmental protection awareness raising, SMEs actively work on the reformulation to find solutions for the lead paint substitution.

No.	Standard No.	Name	Lead limit (mg / kg)
1	GB 18581—2020	Limit of harmful substances of woodware coatings	90
2	GB 18582—2020	Limit of harmful substances of architectural wall coatings	90
3	GB 24409—2020	Limit of harmful substances of vehicle coatings	1000
4	GB 30981—2020	Limit of harmful substances of industrial protective coatings	1000

Barriers

- **High costs for the alternatives**
The cost of organic alternatives are much higher, especially for SMEs which are in low income and low profit.
- **Long-term supply of organic pigments**
Scaled-up substitution can not be supplied by the current market.
- **Increased VOCs emissions**
The thickness of the coating film increases due to the use of organic pigments, causing the increase of solvent use and VOCs emission.

The barriers are not only country-specific, but also may regarded as regional or global issues.

The Economic Evaluation of Reformulated Paints

Company 1-Zhejiang Utop New Material Co.,Ltd Alkyd paint-anticorrosion		
	Lead paints	Reformulated paints
Economic feasibility	The price of red lead pigment is high.	Cost-effective alternative. -Iron titanium powder pigment price is lower than red lead by 40%. -Red oxide pigment price is lower than red lead by 50%.
Availability	Limited	Both Iron titanium powder and Red oxide are available on the market.

-However, this is one of only a few cases that the economic evaluation in cost-effective feasibility, since the lead raw material red lead is in limited resources.

-In most cases, due the high costs of organic alternatives, the overall costs of reformulated paints are high than lead paint.



Lessons learned and best practices

- For the substitution of red lead anticorrosive pigment PR 105, alternative of iron titanium powder could be also used to replace red lead which was tested successfully in our selected SME for pilot testing of alkyd paints. Results showed the colour differences are very slight, and the products own similar properties on the mechanical, drying, rust resistance and that could meet clients' technical requirements.
- PY 42 were tested and showed similar technical properties on the mechanical, drying, rust resistance but due to the dirty chroma, some of the clients could not accept the clear colour difference.
- For the substitution of PY 34, the use of iron oxide yellow or combined with organic yellow pigments could substitute the original lead-containing pigments for epoxy floor paints in green or grey colour, which was tested successfully in our pilot company and will be completely replaced for these colours in months. However, there are still some problems existing such as chroma differences and poor shade functionality need to be improved.
- Consumers cannot identify lead-containing and lead-free paints on the market. There is no label for lead free paints in China.
- There has been challenges of clients' preference on lead paint at some local places. Awareness raising on the lead elimination for customers and the public should be further promoted.



Influence of lead paint laws on reformulation

- NCPC China work closely with the government to regulate the lead paint in China, such as MEE, MIIT.
- On the guidance launching workshop, government officials from SCC MEE, Saidi MIIT were invited to share the government controls and strategies of chemical management in China. Lead paint standards were discussed and we strongly suggested to accelerate the process of the standards issuing in 2019.
- It is of great need to engage with government in the future to encourage reformulation.

No.	Standard No.	Name	Lead limit (TOTAL LEAD) (mg / kg)
1	GB 18581—2020 (GB 18581—2009,GB 24410—2009 were replaced)	Limit of harmful substances of woodware coatings	90
2	GB 18582—2020 (GB 18582-2008,GB 24408—2009 were replaced)	Limit of harmful substances of architectural wall coatings	90
3	GB 24409—2020 (GB 24409—2009 was replaced)	Limit of harmful substances of vehicle coatings	1000
4	GB 30981—2020 (GB 30981—2014 was replaced)	Limit of harmful substances of industrial protective coatings	1000
5	GB 38469—2019	Limit of harmful substances in marine coatings	1000
6	GB 30981—2014	Limit of harmful substances anti-corrosion coatings for construction steel structure	1000
7	GB 24613—2009	Limit of harmful substances of coatings for toys	600 90(soluble)
8	GB18585—2001	Indoor decorating and refurbishing materials-- Limit of harmful substances in wallpapers	90



Conclusions and the way forward: views on the future of reformulation in China

- Provide policy advice to the government to regulate lead paint.
- Work with associations, SMEs, alternative suppliers and relevant stakeholders to promote reformulation.
- Organize workshops or seminars to disseminate the technical guidelines and pilot practices.
- Publications to the greater community to promote the elimination of lead paint.



Thank you for your attention!

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