Stabiliser Sustainability for Vinyl Industry
An Update…

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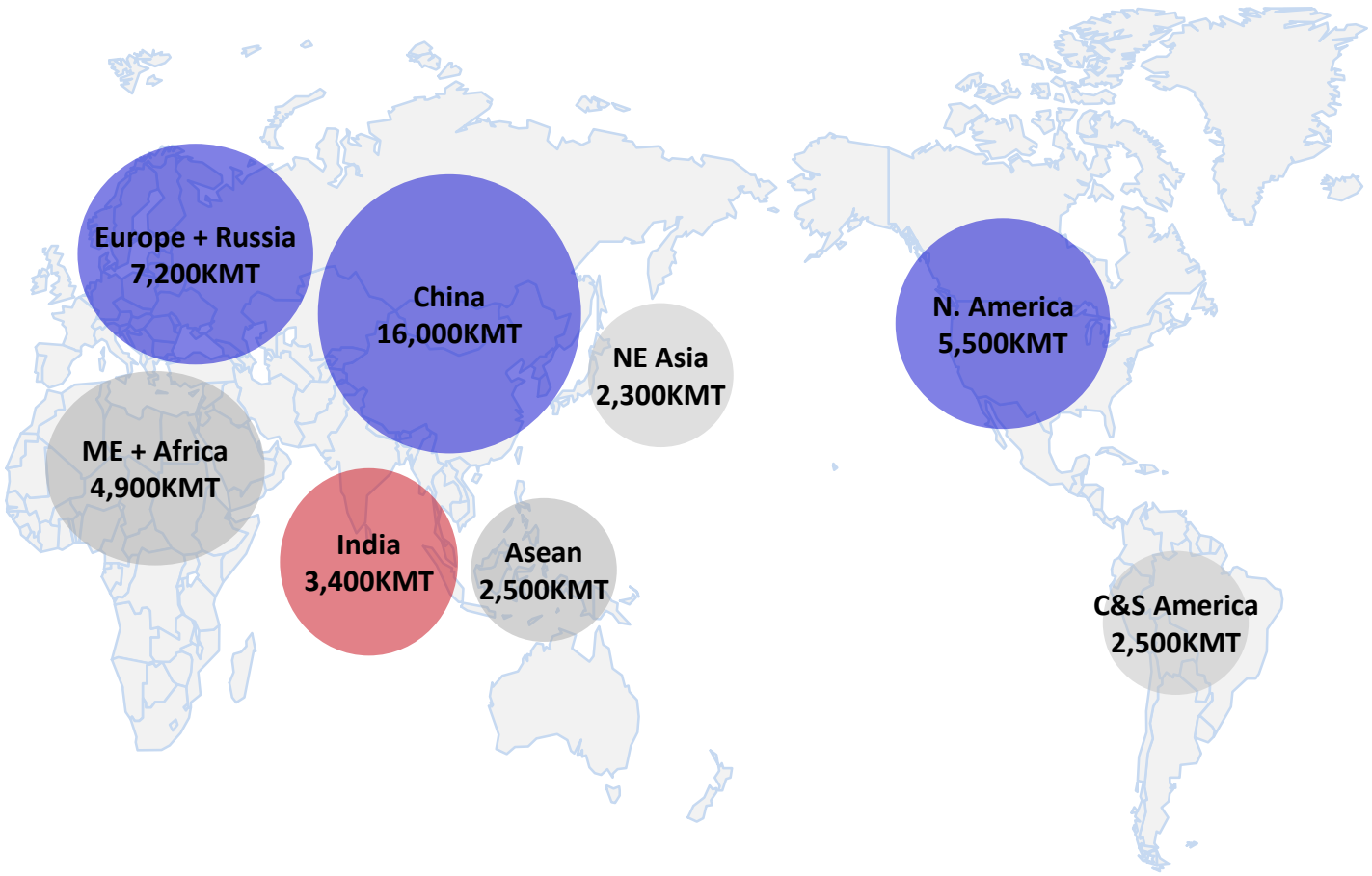
Global PVC Consumption



2019 World Demand estimated to be around 45 million MT

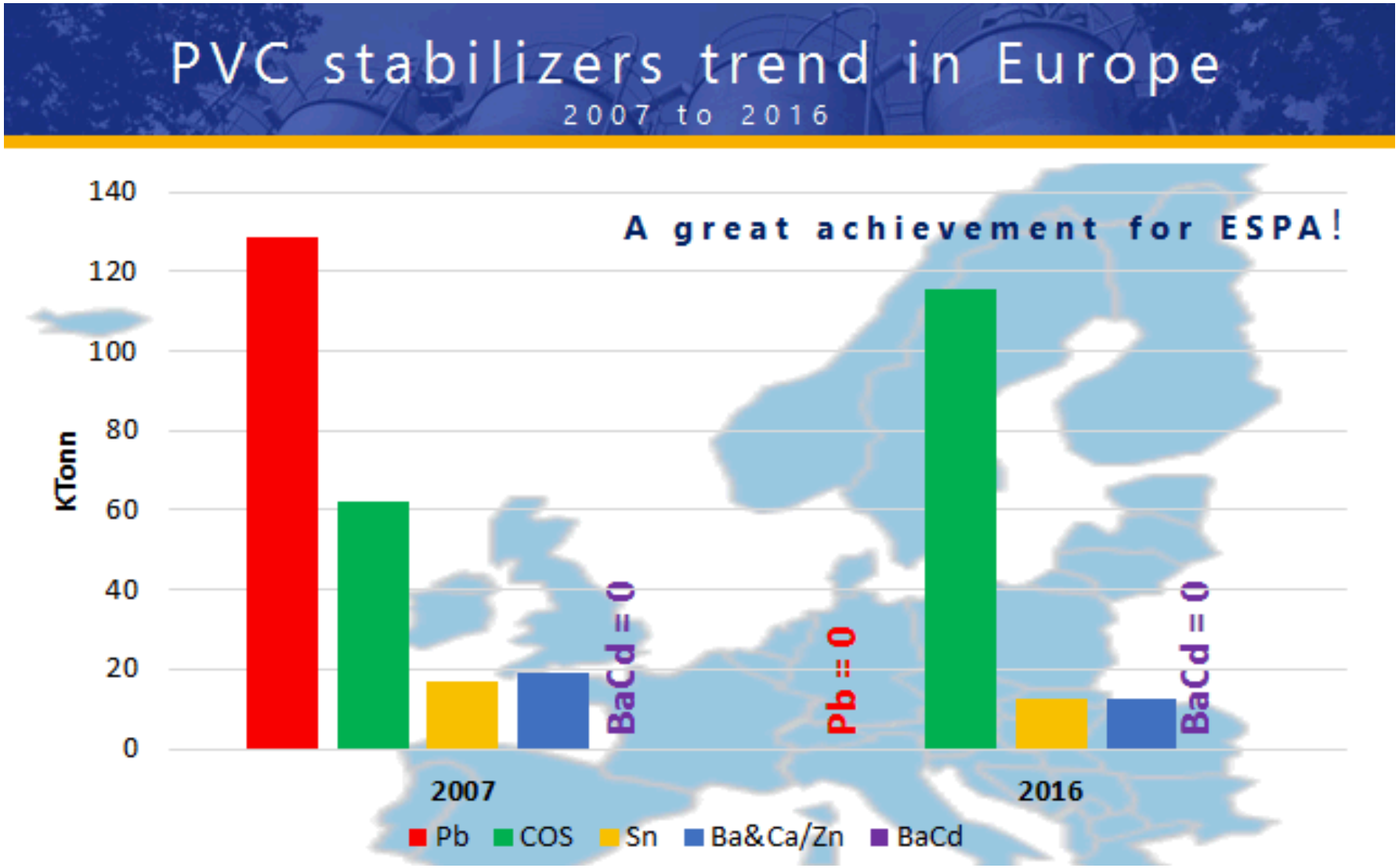
SEA PVC Consumption

2019 SEA estimated to be around 2.5 million MT

Europe 10 Years Ago

- Lead (Pb) stabilisers dominated the European PVC stabiliser market in the early 2000s
- extruded rigid PVC was nearly completely Pb-stabilised
- injection moulding and foam profile extrusion used Sn stabilisers
- first attempts to introduce Ca-based stabilisers for plasticised PVC extrusion (e.g. cables, tubes) had been made

Europe in 2016…



Current Trend

- North America
  - Tin stabilisers dominate the rigid application while CaZn is used mainly in wire and cables
  - BaZn and CaZn are used in flexible applications
  - Proposition 65 in California

- South America
  - Lead & Tin stabilisers dominate the rigid application while CaZn is used mainly in wire and cables. Trend to move away from Tin to CaZn due to the influence of EU.
  - Brazil has switched to CaZn for rigid application.
  - BaZn and CaZn are used in flexible applications

Current Trend

- Middle East / Africa
  - Lead stabilisers dominate most applications
  - South Africa is completely lead free (influence from SAVA and EU)
  - Qatar has regulation against the use of lead compounds but…..

Current Trend

- China
  - Potable water pipes and window profiles have been switched to CaZn. Tin and CaZn stabilisers are used in fittings
  - Pressure mainly from environmental concerns

- Australia/New Zealand/Taiwan/Japan/Korea
  - Lead free for potable water pipes (most CaZn except for Tin in Taiwan)
  - Some lead still used in fittings/power cables

Current Trend

- India
  - NGT (National Green Tribunal) has pushed for non-lead stabiliser system
  - Implementation may take 2 years as stakeholders lobby for longer grace period
  - CaZn is the preferred choice

Current Trend

- Singapore/Vietnam/Indonesia/Philippines
  - Major pipe producers have switched to non lead (Mainly CaZn)
  - There are still some lead as there is no regulation against the use of it.
- Thailand
  - Major pipe producers have shown interest to switch and waiting for regulation to be gazette.

Control of Lead Stabiliser Systems in Asia

- Whilst lead stabiliser system is still permitted, the effect on lead extraction/leachate on drinking water limits varies within the Asia region:

China	GB17219	5 ppb
Japan	JIS K 6742	8 ppb
Taiwan	CNS 45053-1	8 ppb
Korea	KSM3600	8 ppb
Thailand	TIS 17	10 ppb
Vietnam	QCVN 16-4	10 ppb
Singapore	SS 375 (Potable)	10 ppb
Malaysia	MS1583	10 ppb
Philippines	PNS 65	50 ppb
India	IS:4985	50 ppb
Indonesia	SNI06-0084-2002	300 ppb

Changes in Stabiliser

Changes worldwide are driven by:

- Regional and country wise regulatory requirements e.g. REACH directive in Europe
- Voluntary industry commitment and action

Overview of Lead Stabilizers under REACH

Type	GHS Classification	REACH Registered
Lead	Reprotoxic Category 1a	SVHC list
Lead monoxide (lead oxide)	Reprotoxic Category 1a	SVHC list
Tetralead trioxide sulphate	Reprotoxic Category 1a	SVHC list
Fatty acids, C16-18, lead salts	Reprotoxic Category 1a	SVHC list
Sulfurous acid, lead salt, dibasic	Reprotoxic Category 1a	SVHC list
[Phthalato(2-)]dioxotrilead	Reprotoxic Category 1a	SVHC list

Overview of Tin Stabilisers under REACH

REACH is setting the tone for Tin Mercaptide stabilisers future use:

Type of Tin	Stabiliser	GHS Classification	REACH Registered
Methyltin	Mono-	Reprotoxic category 2 Mutagen category 2	Yes
	Di-	Reprotoxic category 2	Yes
Octyltin	Mono-	No CMR classification	Yes
	Di-	Reprotoxic category 1b	SVHC list
Butyltin	Mono-	No CMR classification	Yes
	Di-	Reprotoxic category 1b	SVHC list

Note: SVHC – substances of very high concern

Restrictions on use of Tin Stabilisers

Commission Decision 2009/425/EC amending Directive 76/769/EEC (now REACH Annex XVII):

Type	Restrictions on use	Effective Date
Mono-methyltin Di-methyltin	No classification change or restriction on applications expected	Last reviewed Sep 2015
Di-butyltin	Restrictions on all applications	1 Jan 2015
Di-octyltin	Use allowed in all applications except - Textiles articles coming into skin contact - Gloves - Footwear or part of footwear coming into contact with skin - Wall and floor coverings	1 Jan 2012

CaZn ONE PACKS BY APPLICATION – CABLES REGULATIONS

RoHS Requirements – Prohibited Substances:

Guidelines for new electrical/electronic equipment

Substances	**Threshold Value from 1 July 2006 (%)**
Lead (Pb)	0.1 (1000ppm)
Mercury (Hg)	0.1 (1000ppm)
Cadmium (Cd)	0.01 (100ppm)
Hexavalent Chromium (Cr^{6+})	0.1 (1000ppm)
Polybrominated Biphenyl (PBB)	0.1 (1000ppm)
Polybrominated Diphenyl Ether (PBDE)	0.1 (1000ppm)

Comparison between the systems

Lead

- Good Opacity
- Excellent heat stability and weathering properties
- Wide processing window
- Good colour hold

- Toxicity
- Cross-contamination with Tin
- Environmental hazard

Tin

- Good flow
- Excellent transparency
- Good colour hold
- Good initial colour

- Toxicity
- Cross-contamination with lead
- Poor Opacity/weathering
- Single Stab
- Strong Odour
- Lower Vicat Softening Pt

Ca-Zn

- Environmental and health friendly
- Acceptable opacity
- Acceptable heat stability
- Good Weathering properties

- Poor colour hold
- Narrower processing window
- Possible plate out issues

Industry Trend on PVC Stabilisers

International Regulations over Stabiliser Systems

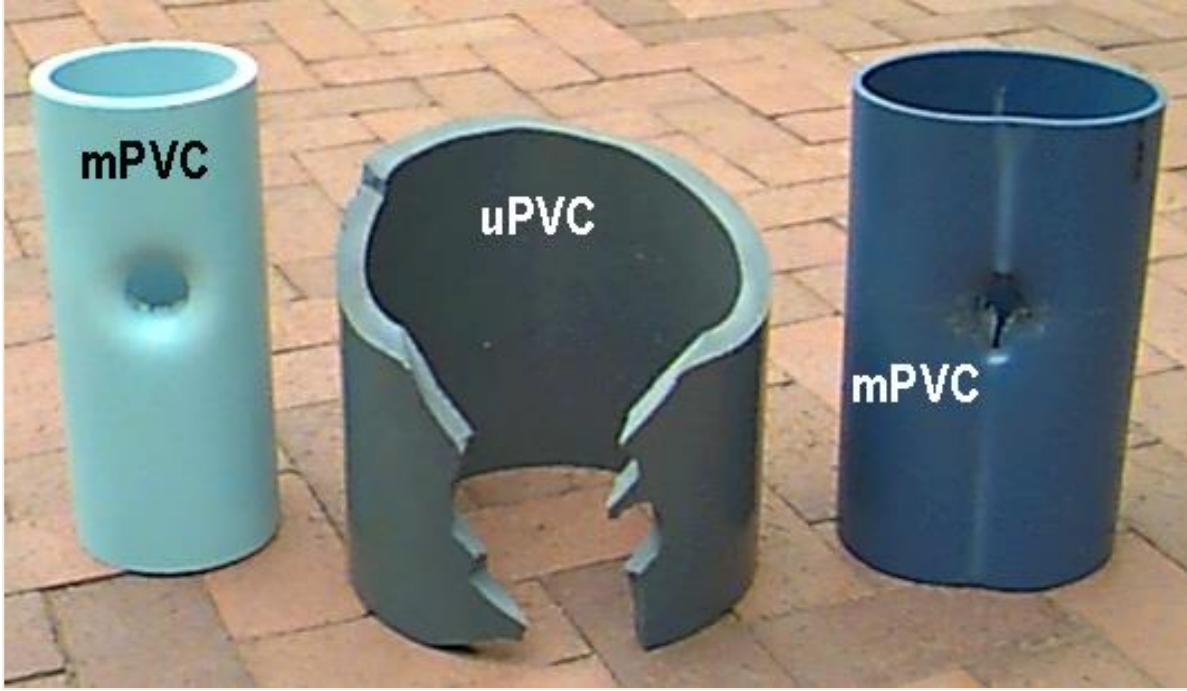
- ROHS and WEEE for wire and cable
- EN71 for toys
- GADSL for car industry on hazardous material
- REACH SVHC List
- 2008 - 15 substances
- 2019 (Jul'19) - 201 substances
- Many more on the way…..

Future Scenario

- The PVC industry has a good future on a global basis.
- Additives including stabilisers are available to ensure sustainable use of PVC as a complete system.

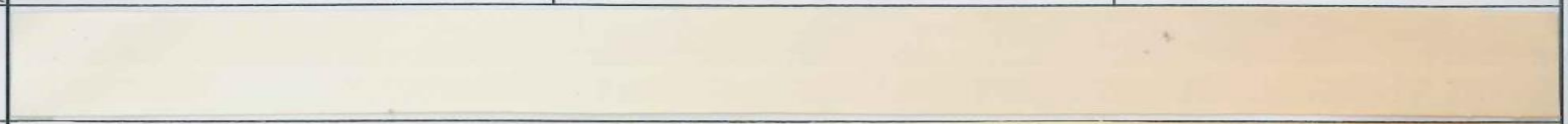
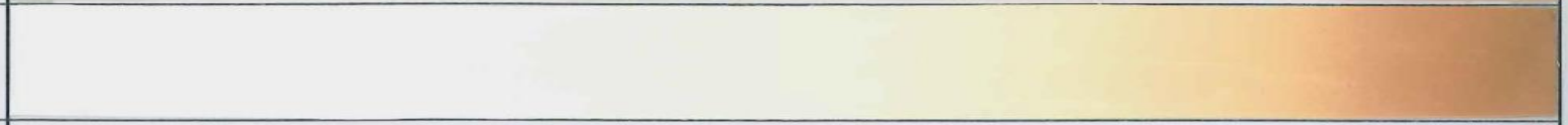
Stabiliser Systems for M-PVC & O-PVC Pipes

M-PVC Pipes



PVC Stabilisers Systems for M-PVC

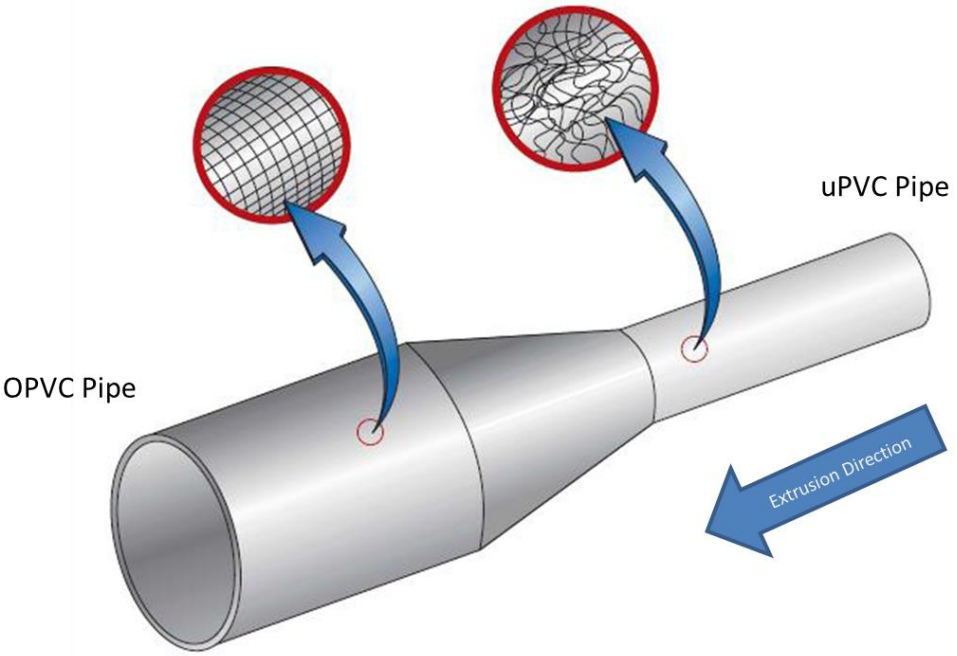
Heat Stability Test for MPVC

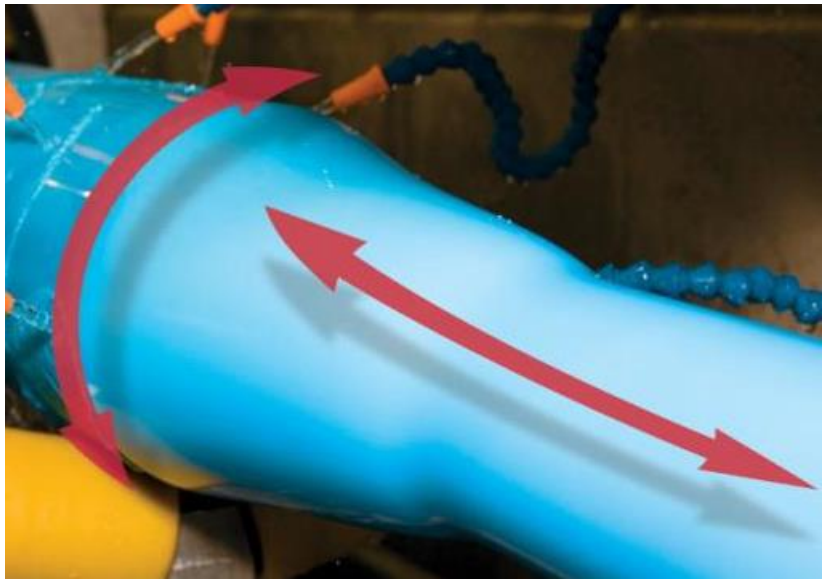
Conditions / Sample	Roll Temp. X Time: 190°C X 5 mins	Oven Temp. X Time: 190°C X 60 mins	
Lead			
Ca-Zn			

Formulation (Phr)							
PVC	100						
Stabiliser	3.30						
TiO_2	1.50						
$CaCO_3$	3.00						
Impact modifier, CPE	6.00						

Size (200mm PN16)	Thickness (mm)	Weight (Kg)
PVC-U (SANS-996-Part 1)	12.1	66.9
PVC-M(SANS-996-Part 2)	8.6	48.2

O-PVC Pipes





PVC Stabilisers Systems for O-PVC

Heat Stability Test for OPVC

Conditions / Sample	Roll Temp. X Time: 190°C X 5 mins	Oven Temp. X Time: 190°C X 60 mins	
Lead			
Ca-Zn			

Formulation (Phr)							
PVC	100						
Stabiliser	3.30						
TiO_2	1.50						
$CaCO_3$	3.00						
Processing Aid	0.30						

Size (225mm PN16)	Thickness (mm)	Weight (Kg)
PVC-U (AS/NZS 1477 S2)	15.9	112
PVC-O (AS/NZS 4441 S2)	7.1	52

ASEAN VINYL COUNCIL

The success of Our Companies depends on the success of PVC

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Acknowledgements

ASEAN VINYL COUNCIL

Associate Members – Stabiliser Producers

ADEKA BAERLOCHER SUNACE