



A Journey Away from Lead

Lim Boon Peng



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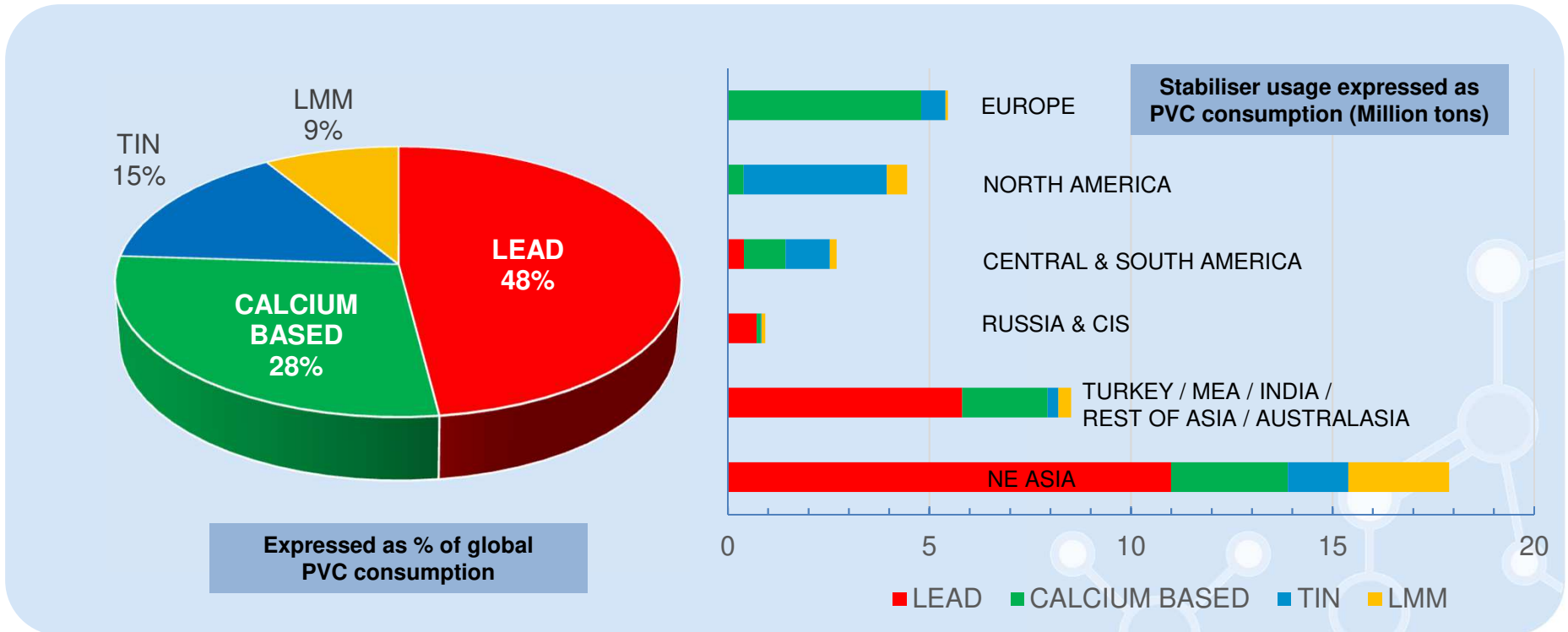
PVC Stabilisation landscape at the turn of the millenium

- Pb-based stabilisers
 - Dominated rigid extrusion except US where tin is used
- Tin-based stabilisers
 - Rigid extrusion in US
 - Injection Moulding and foam profile extrusion
- Ca-based stabilisers
 - Initial attempts for plasticised extrusion (e.g. cables, tubes) have been made



Analysis of global stabiliser demand 2016

With a few exceptions, PVC converters were almost free to formulate without legislation



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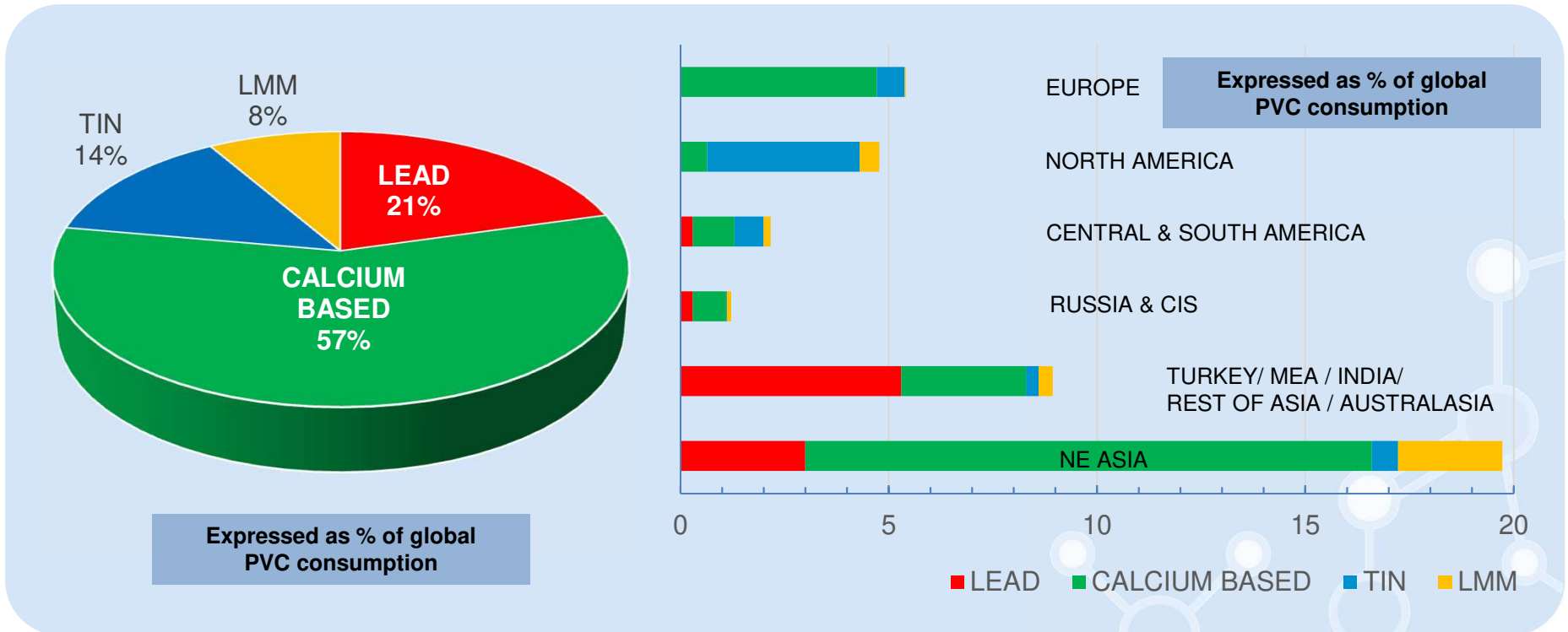
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Analysis of global stabiliser demand 2019

Substitution of Lead stabilisers in Russia, Turkey, ASEAN and China by Calcium based stabilisers



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PVC getting bad press in the early 2000s

- Chlorine Chemistry got under pressure after the Seveso incident
- Plasticisers were under discussion
- As a result PVC was deselected for the use in communal construction work
- Focus was also given to Pb based stabilisers



Legislative pressure on Pb stabilisers

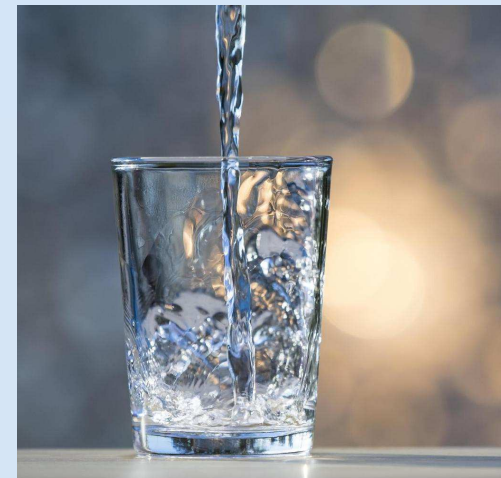
- REACH & RoHS legislation
- The European Plastics Pipe and Fitting Association (TEPPFA) discussing a voluntary switch away from Lead stabilisers until end of 2010 (- 75%)
- Voluntarily switches in some regions (Brasil, Australia,) “to be ahead of the game”



South East Asia : A step towards 'greener' product

Further substitution of Lead expected: -

- Thai Industrial Standard for drinking water pipe without Lead
- Malaysia, MS628 National drinking water pipe standard without Lead
- Market demands now forces smaller players to follow suit
- Fittings being formulated without Tin and Lead



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PVC at a crossroad

- Replacement of Lead by Tin was discussed, based on US technolog
- Ca/Zn Stabilisers were already available for certain applications and have been tested for rigid extrusion in many places
- Some stakeholders asked whether in general it would make sense to replace one heavy metal (Pb) by another one (Zn), or whether one should directly move to heavy metal free solutions?
- This discussion triggered two things
 - Development of OBS stabilisers
 - Discussion about hazard of Zinc components



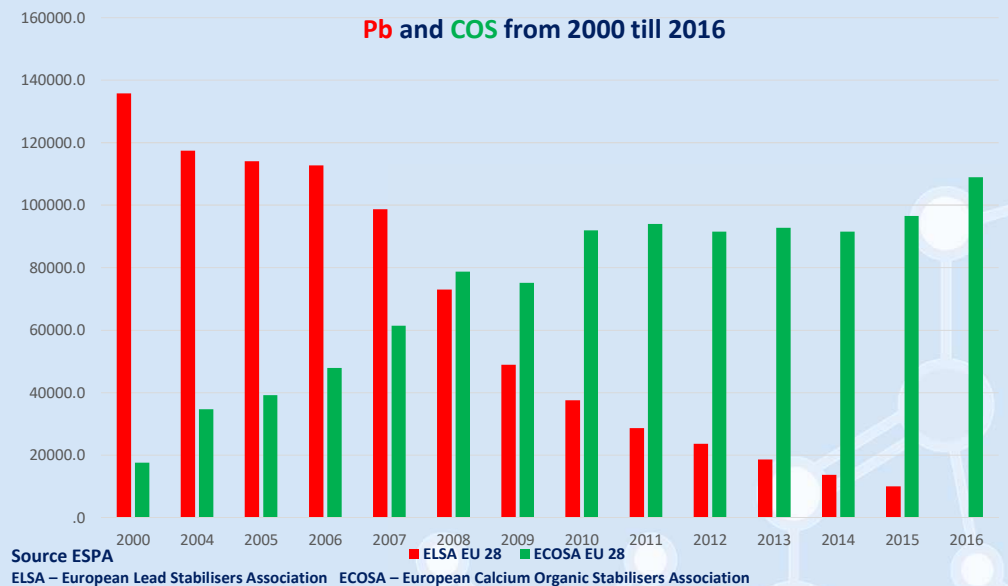
Ca-based stabilisers - terminology

- **Ca-based** and **Calcium organic stabilizer (COS)** are the most generic names
 - Similar basic composition using inorganic acid scavengers, Ca-soaps and other lubricants
 - May contain a huge variety of different organic costabilisers, e.g. Zinc soaps
- **Ca/Zn-Stabilisers** are based on the same building blocks, but necessarily contain Zinc containing ingredients
 - Zinc components support good early colour and weatherability
- **OBS™** is based on a patented combination of two costabilisers
 - Otherwise stabiliser base is as stated for Ca-based
- The term “**Metal free**” disappeared since it was misleading (inorganic acid scavengers are based on Al, Ca, Si,)
- Sometime **heavy metal free (HMF)** is still used to express absence of Zinc



The change in stabilisation took its time

- The PVC cable industry started to introduce Ca-based stabilisers.
- Statistics show that it was not a quick switch



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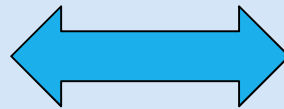
Converters needed to re-learn PVC extrusion

- As well experience needed to be built up for converters
 - A couple of “rules of thumb” didn’t work any longer (if it is working of that machine it works everywhere, if in doubt use more stabiliser, ...)
 - Differences between processing units has been underestimated
 - Due to different processing window using Ca-based stabilizers more accurate fine-tuning of one-packs was necessary



Soon Tin stabiliser have not been perceived as an alternative for rigid extrusion

- Liquid Tin stabiliser require different dosing units compared to solid one-packs
- Tin stabilizer require additional lubricant dosage
- When comparing cost often the lubricant part is neglected
- Tin stabilised dryblend shows different plastification behaviour
- Converting Tin based dryblend often causes higher wear and tear
- Systems need to be completely Lead free → cross staining



Ca based has been considered to be the better option

- Equipment doesn't need to be changed since Ca-based stabilisers are also solid one-packs
- Rheology can be adjusted to match with Lead stabiliser one-packs
- Fully compatible with Lead based stabilizers
 - No cross-staining
 - Lead based regrind still can be used
- Considerations about Zinc as a heavy metal went quiet, use of Zinc is safe in all aspects
- Window profile extrusion is predominantly made using Ca/Zn stabilisers
- In pipe application Zinc free stabilisers got some share but are occasionally replaced by Ca/Zn stabilisers as well



Summary

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Summary I

- **Legislation pressure plays a key role in Phase-out of Lead stabilisers and this did not happen overnight**
- **It was achieved in Europe with a transition of ca. 10 years as stakeholders were going through a learning curve again**
- **Change to either Ca-based or Tin-based poses their own pros and cons**
- **Drop-in solution is not workable**



Thank you for listening!



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