



1 |Aug.11th| Baerlocher | Stabilisation in PVC Wire and Cables | BP Lim

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The AVC Sustainability Forum 2023: Moving Forward to Vinyl Sustainability – The Episode of Additive System for Wire and Cable Application

PVC Cable Stabilisation - Advances & Challenges

Lim Boon Peng

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Agenda

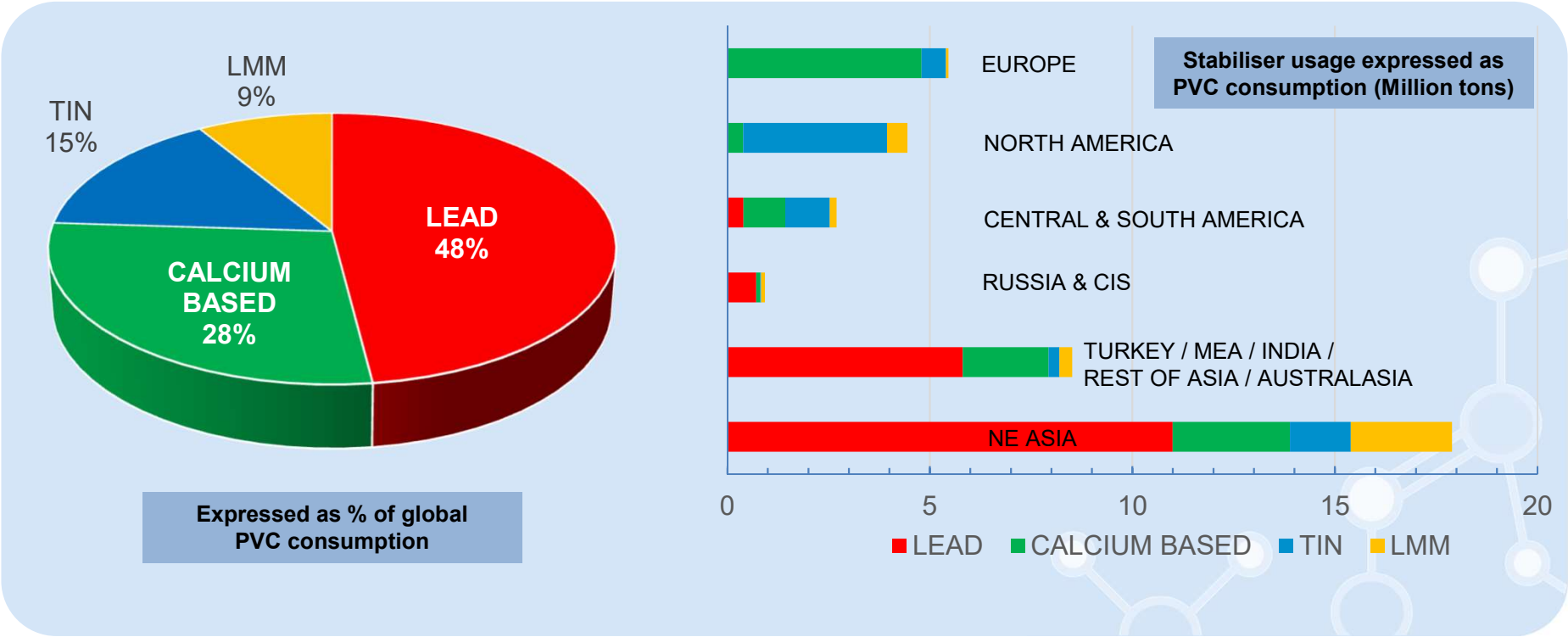
- **Market data**
- **History of the change**
- **Pb stabilisers – a review**
- **Ca/Zn- based stabilisers – general concept**
- **How to measure stabilisers performance + FAQ**
- **Summary**
- **Baerlocher Malaysia products overview**



Market Overview

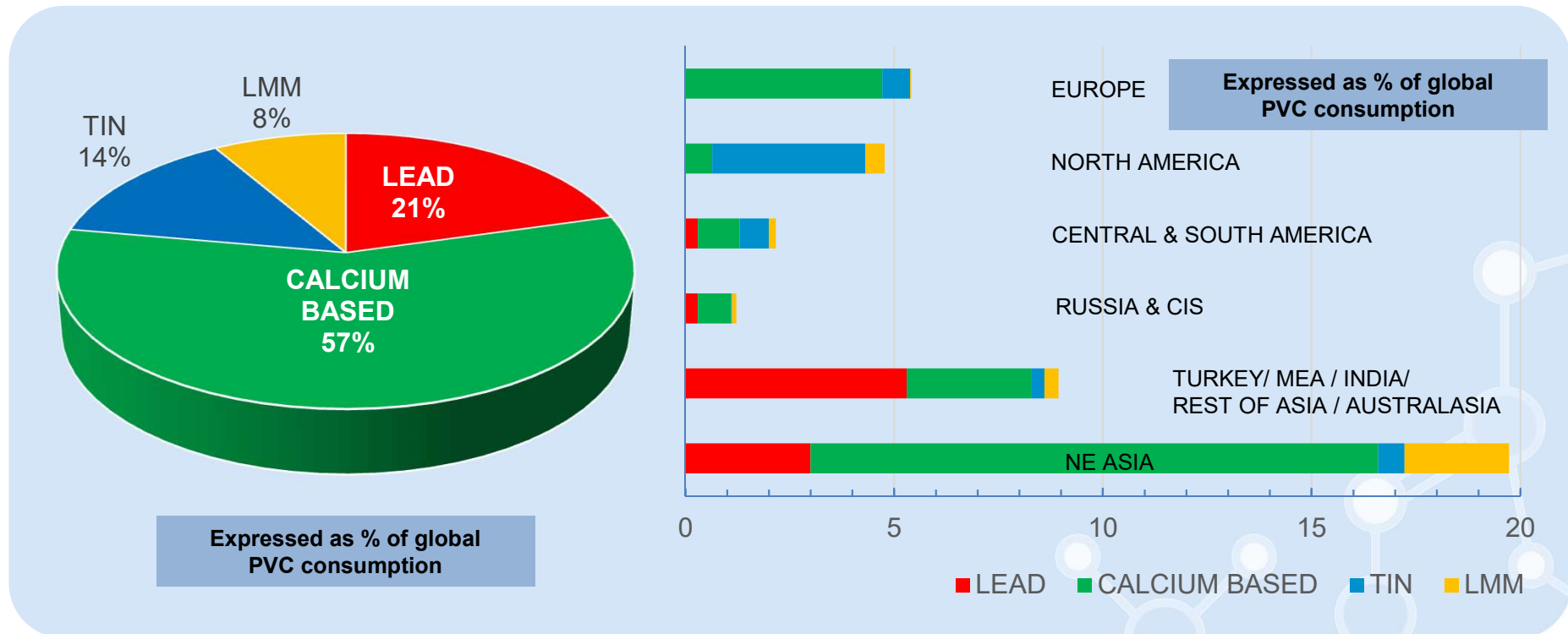
Global stabiliser demand landscape in 2016 for all applications

PVC converters is almost free to formulate without legislation with the exception of some



Global stabiliser demand landscape in 2019 for all applications

Adoption of Ca-based solution in Russia, Turkey, ASEAN and China



What happened in Europe's PVC Industry 20 years ago?

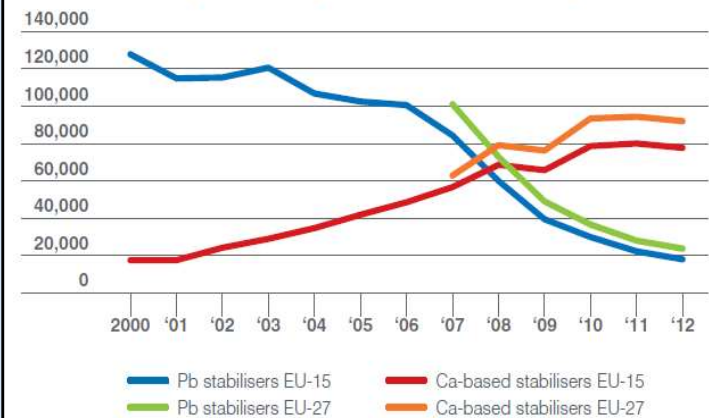
Several initiatives paved the way to Lead-free:

- PVC industry's voluntary commitments: "Vinyl 2010"
- Automotive industry lowered the heavy metals limits in cables
- Lead-containing chemicals are classified as hazardous substances

Driving forces for cable industry in EU

- ELV (End-of-Life Vehicles Directive)
- RoHS (Restriction of certain Hazardous Substances)
- WEEE (Waste from Electrical and Electronic Equipment)
- REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals)

Stabilisers production data (in tonnes)
EU-15 & EU-27 (plus Norway, Switzerland and Turkey)

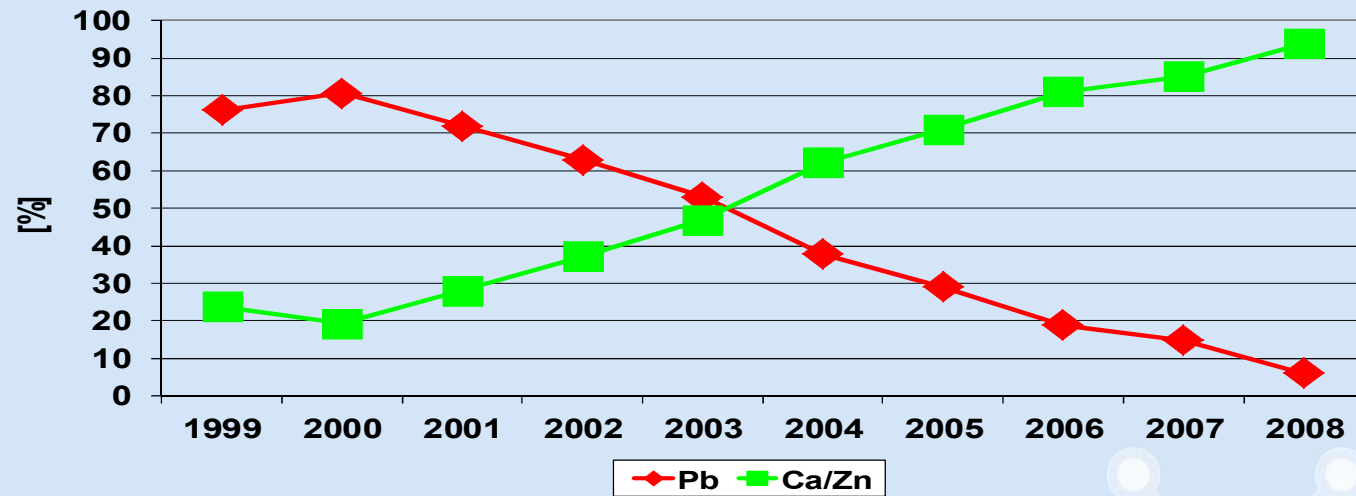


Increasing Pb prices and regulatory pressure were accelerating the switch



The cable market changed steadily.

- The PVC cable industry started to introduce Ca-based stabilisers in Automotive grades.
- It took about seven years to switch the European cable producers to Ca/Zn stabilisers.



Source:
Baerlocher



PVC Stabilisation System

Lead-based Cable Stabilisers Systems

Variation of dosage allows many adjustments!

- Lead salts: tri-basic lead sulfate (TBLS), di-basic lead phthalate (DBLP)
- Additional Lead stearate acts as heat stabiliser and lubricant.
- Lead metal content of cable stabiliser one-packs ca 60% – 70%.
- Close correlation between Lead content and thermostability (Congo Red).
- Increased lubrication by increased stabiliser dosage.

High performance of Lead-based stabilisers

- Good initial colour due to pigmenting properties of inorganic Lead compounds.
- Excellent long-term thermostability.
- Broad processing window.
- Linear correlation between dosage and performance.



Calcium-based Stabilisers System

Calcium-based stabilisers

- ... is a general term for all stabilisers without Lead, Barium, Cadmium and Tin

current systems are based...

- on Acid scavengers
- on Calcium and Zinc metal soaps
- contain internal lubricants e.g ester waxes, ...
- contain external lubricants e.g paraffines, PE waxes, ...
- contain co-stabilisers to influence early colour and colour hold
- contain Antioxidants to maintain long term stability



Adjustments are necessary

Managing the change means knowing about general properties and necessary changes of a Ca/Zn cable stabilisation:

- underdosing or overdosing of Ca/Zn stabiliser will reduce its performance
- Simple increase of stabiliser dosage does not automatically boost overall performance
- Rheology adjustment is more critical
- influence on Ca/Zn stabiliser performance by additional components: Ca stearate, CPE, CPW, stearic acid
- heavy metal pigments have to be replaced completely to be “heavy-metal-free”



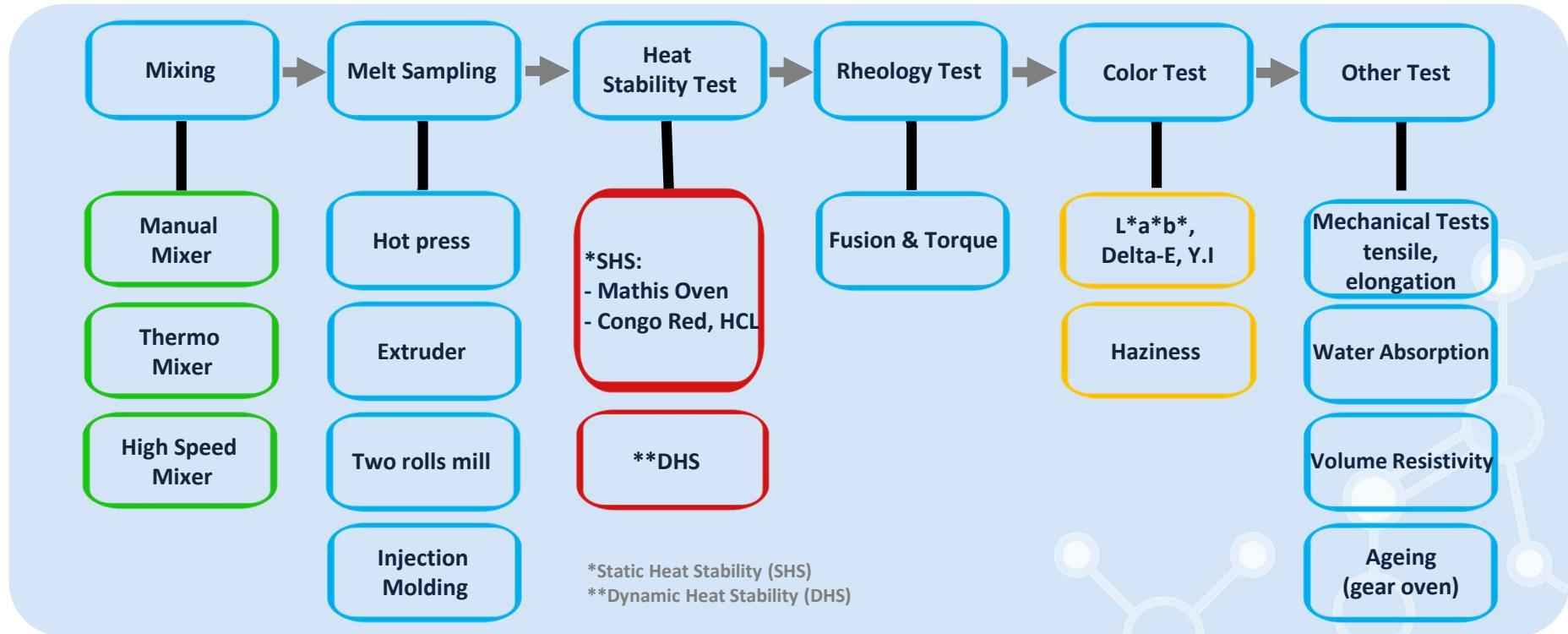
General properties of Ca/Zn stabilisation to take into account.

- Processing windows got smaller.
- Congo Red thermal stability was equal, however the colour hold during processing was reduced.
- Colour adjustments have been necessary due to missing self pigmentation effect of lead based stabilisers
- Water absorption properties of compound is depending on the stabiliser base and must be respected.
- Storage stability of stabiliser and cable compound depending on the stabiliser base had to be established.



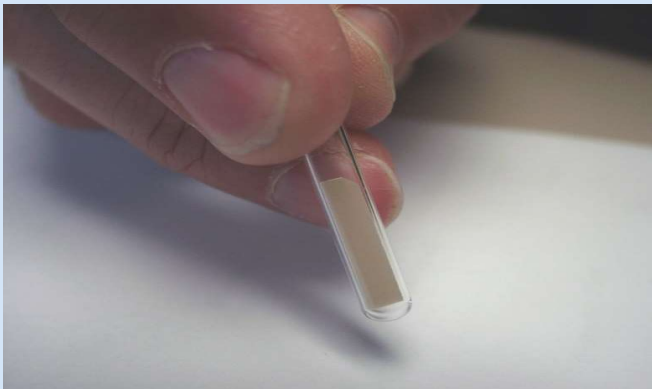
Choosing the “Right” Product

How to measure stabilisers performance

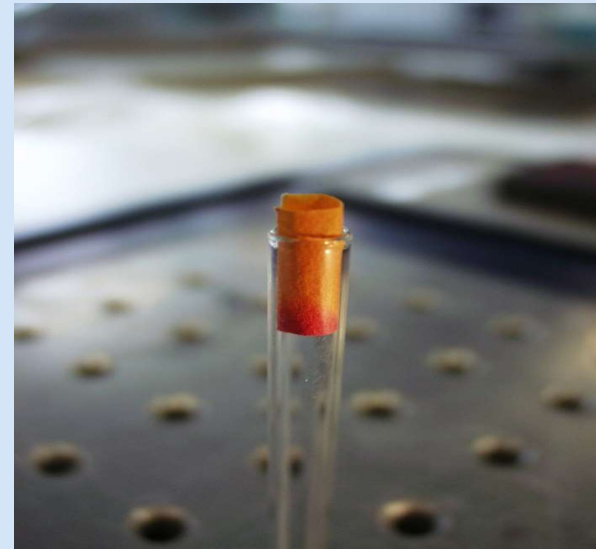


Static stability performance (Congo Red)

- Congo Red [min at 200° C]
- VDE Stability
- THERMAL STABILITY TEST



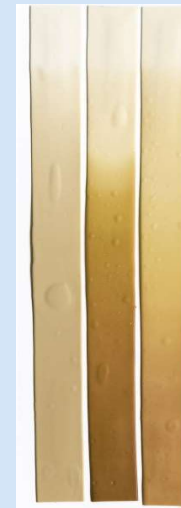
Sample in glass tube



Discoloration of Congo Red paper

Static stability performance (colour hold)

■ Mathis Test (static heat stability)



Time
in the oven



Compound Performance

- **Mechanical properties after oven ageing**
 - Elongation at break
 - Tensile strength



How NOT to measure performance of Ca/Zn stabilisers for cables

The pure physical properties of the stabiliser formulation do **not** allow a conclusion to the performance as a stabiliser:

Density or ash content

- are used to check on the lead content, representing the efficiency to stabilisation. Raw materials that are efficient in Ca/Zn stabilisation do not necessarily contribute to density and ash content.

Volatile content of a decent stabiliser should only be humidity

- as a measure of absorbing humidity is a property of stabiliser formulations that might require handling precautions but is not linked to the stabilising performance of the formulations.
- It is linked to used raw materials that are chosen to fulfil certain stabilising needs in the final product.



Frequently Asked Questions (FAQ)

Shelf Life of Calcium-based Stabilizers

How to store *Ca/Zn stabiliser*?

- Stabiliser should be stored under appropriate conditions (dry, moderate temperatures).
- The shelf life is an individual property of each stabiliser and can range from half up to one year.
- Your local representative can confirm this information for your individual stabiliser in use.

How to store *Ca/Zn stabilised PVC cable compound*?

- Due to the nature of *Ca/Zn stabilised PVC granules* to absorb humidity, the time is strongly dependant on storage circumstances and *Ca/Zn stabiliser* itself.
- In a dry surrounding we recommend to use it within 3 to 4 weeks. If cable compound granules by rule of thumb exceed the limit of 1000 ppm humidity problems in cable extrusion will occur: Pin holes, plate out etc.
- In case of exceeding 1000ppm humidity, drying of the granules is possible without problems. (70-80°C/3h) without losing any performance.



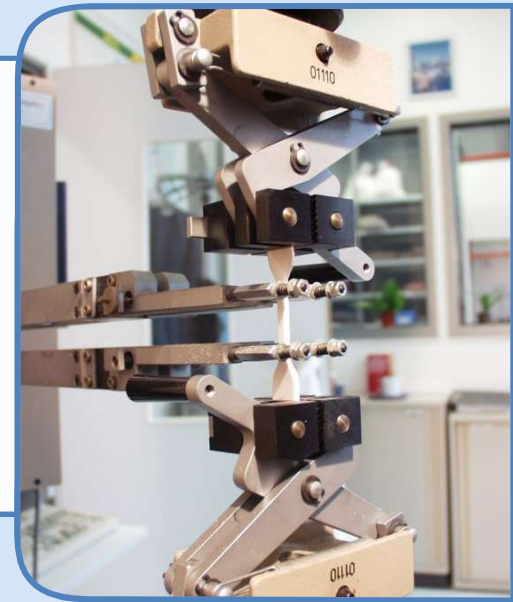
Infrared moisture analyser



Mechanical properties: Tensile strength and elongation at break

The effect on the mechanical properties is only indirect by influencing the gelation level during processing:

- The lubrication level of lead based components are in general lower than Ca/Zn stabiliser one packs.
- The key is to match the same lubrication effect to maintain the same processing conditions
- The problem: Each customer has individual lead based recipes to match.
- It might make sense for the customer to adjust the level of additional lubricants in the overall head recipe.
- Processing adjustments may be an option but it is relying on the customer machinery setup.



Summary

Ca/Zn stabilisers offer key advantages

- Fulfilling all known legal requirements for producing cables worldwide
- “Environmentally friendly” stabilisation
- No exposure of heavy metals to the manufacturing personnel
- Commercially attractive

Baerlocher is supporting the industry.

- We still consider Lead based stabilisers as experienced, versatile and robust
- Considering our Global experience we are able to offer Ca-based stabiliser one-packs for all applications.
- Customers attempts to introduce Ca-based stabilisers will be supported by our knowledge.

BAERLOCHER
WILL SUPPORT YOUR
MARKET WITH
LOCAL TALENTS
+ *GLOBAL*
EXPERIENCE



Calcium-based Stabilizer

Flexible PVC: Wire & Cable

Application Scope	Grade	Appearance	Dosage (phr)	Product Characteristic
< 90°C				
Light Pigmented	MC 92529 KA	Powder	3.0 - 6.0	Economical grade, BS EN 70°C / IEC 70°C excl. PVC/B / UL 60-75°C
	MC 90827 KA	Powder	3.0 - 6.0	Standard grade, BS EN 70°C / IEC 70°C excl. PVC/B / UL 60-75°C
Dark Pigmented	MC 91717 KA/2	Powder	3.0 - 6.0	Standard grade, BS EN 70°C / IEC 70°C / UL 60-75°C
90 - 105°C				
Light Pigmented	MC 91660 KA/4	Powder	3.0 - 6.0	Standard grade, BS EN 70°C / IEC 90°C excl. PVC/E & PVC/ST10 / UL 90-105°C
Dark Pigmented	MC 90224 KA	Powder	3.0 - 6.0	Standard grade, BS EN 70°C / IEC 90°C excl. PVC/E & PVC/ST10 / UL 90-105°C
> 105°C				
Light Pigmented	MC 8656 KA-ST	Powder	5.0 - 8.0	Standard grade, BS EN 90°C / IEC 90°C / UL 90-105°C
	MC 8553 KA-ST/23	Powder	10.0 - 12.0	ISO 6772: Automotive Class B (100°C), BS EN 90°C / IEC 90°C / UL 90-105°C
Dark Pigmented	MC 8890 KA/2	Powder	8.0 - 15.0	ISO 6772: Automotive Class C (125°C), BS EN 90°C / IEC 90°C / UL 90-105°C
Transparent				
Transparent	MC 9875 KA	Powder	1.5 - 2.5	Standard grade, good transparency and initial colour.

IEC PVC/B, HCl ≥ 100min

IEC PVC/E & PVC/ST10, HCl ≥ 180min

BS 90C T1 3/TM 3, HCl ≥ 240min

International Standard ISO 6722, 3000hr aging





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