

New Metallocene EPDMs for Expanded Attribute Range to Meet New Rubber Market Requirements



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BPRI Nov 25, 09 seminar: new challenges for the polymer transformer

Brussels - Belgium

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Chemical

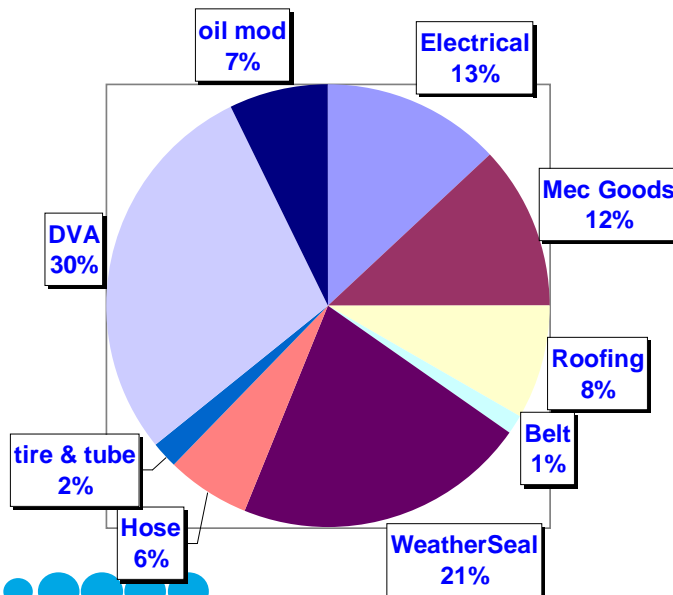
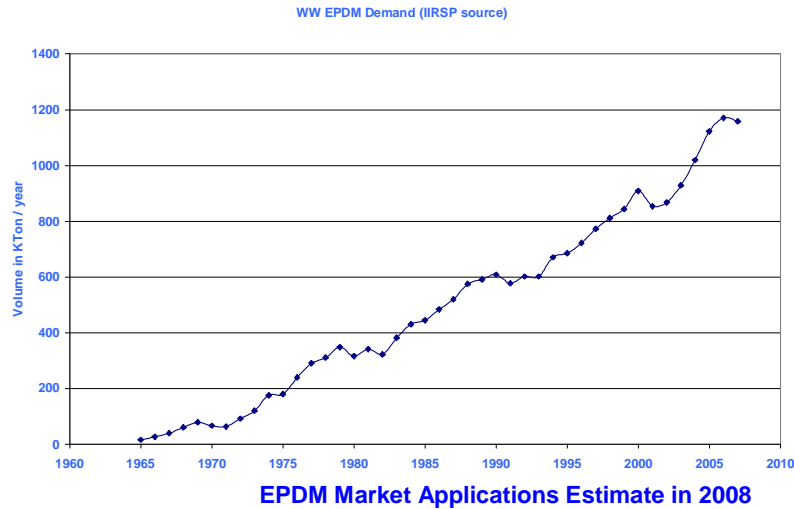
Outline



- **Background**
 - EPDM rubber market
- **Description of Metallocene EPDMs**
- **Materials**
- **Evaluation Results and Discussion**
 - Rheology
 - Physical properties
 - Processing
- **Conclusion - Future Work**

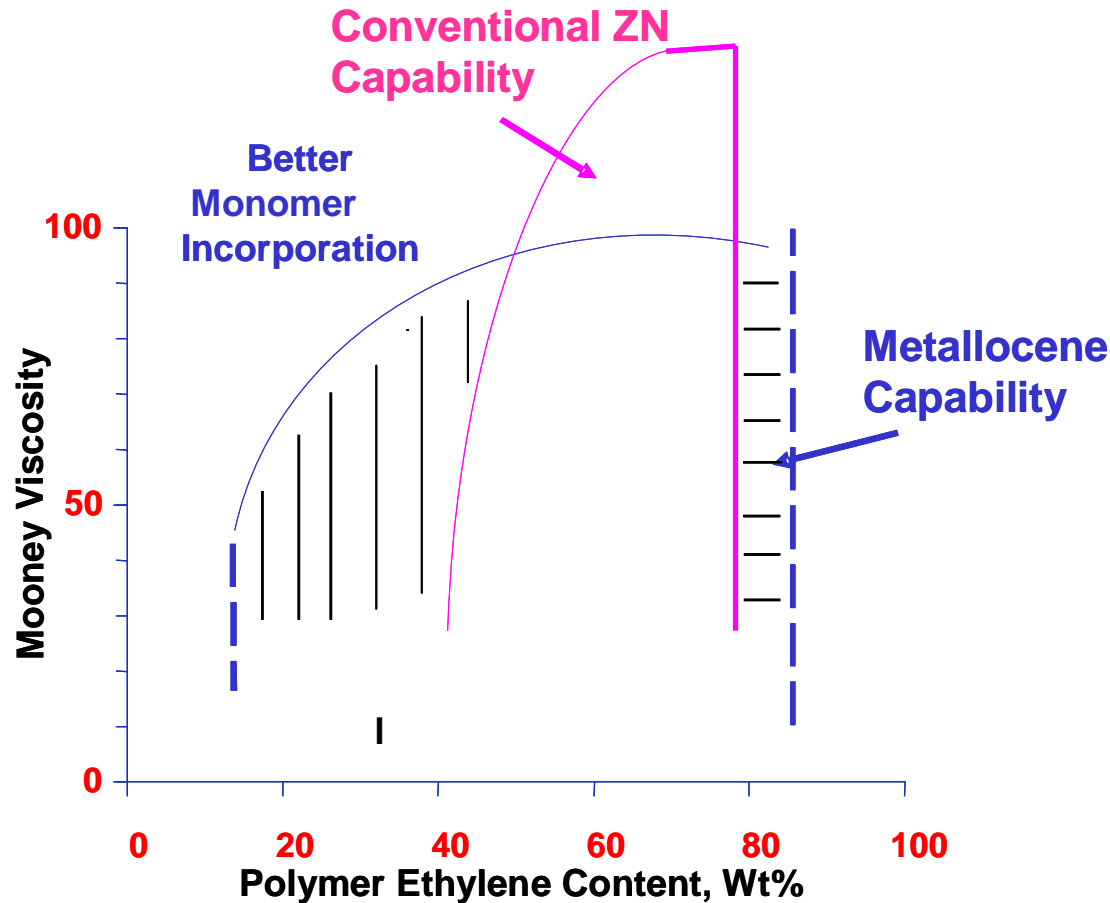


Background

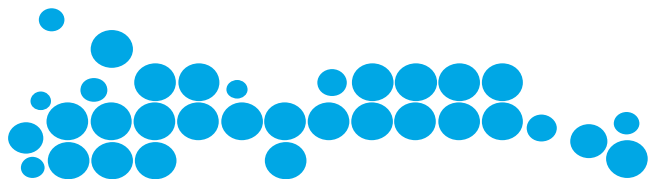


- EPDM is the 3rd synthetic rubber, showing a continuous growth since its introduction
- Applications: close to 50% are in relation with automotive industry
- ExxonMobil Chemical is at the forefront of the EPDM innovations

Metallocene EPDMs Description



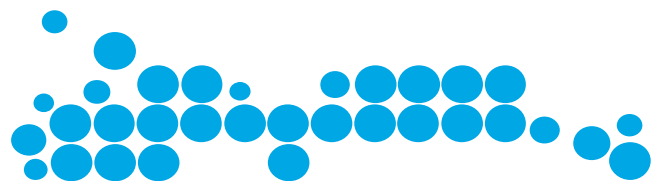
- The conventional Ziegler Natta catalyst provides high MW, broad MWD and high ENB capability
- The metallocene catalyst increase the EPDM capabilities with uniform molecular architecture and enlarged properties



Materials Selected for Evaluation

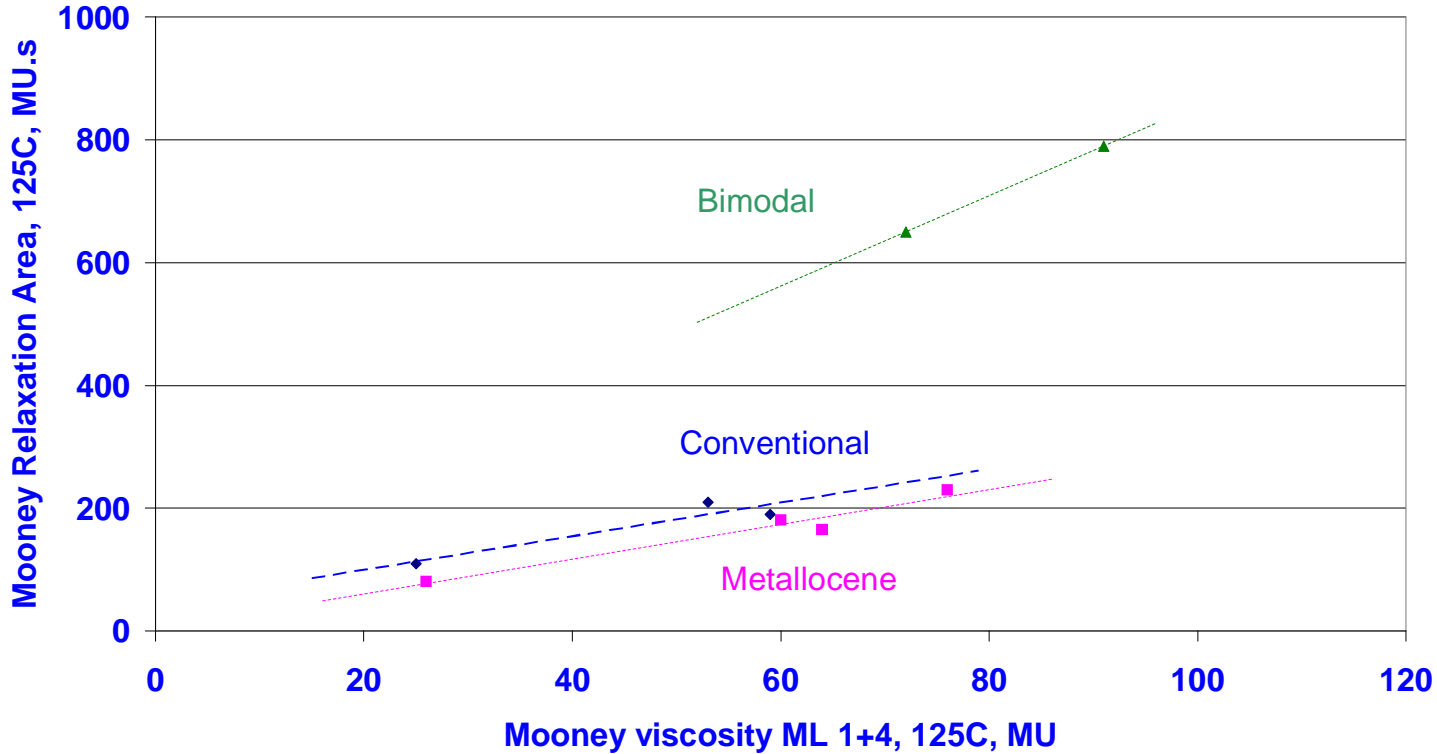
sample	catalyst	C2 content [wt %]	ENB content [wt %]	ML(1+4) 125 °C [MU]	MLRA [MU.s]	MWD
A	Mcn	50	5	26	80	narrow
B	ZN	55.5	3.8	25	110	broad
C	Mcn	55	7	64	165	medium
D	ZN	56.5	9.2	53	210	broad
E	Mcn	73	5	60	180	medium
F	ZN	73	5	59	190	medium
G	Mcn	55	5	76	230	medium
H	ZN	55.5	5.7	91	790	bimodal

- In this study, we compared EPDM with similar molecular weight, but different polymerization platform with different molecular weight distribution, as illustrated by the MLRA



Results: Molecular Weight Distribution

EPDM Molecular weight Distribution

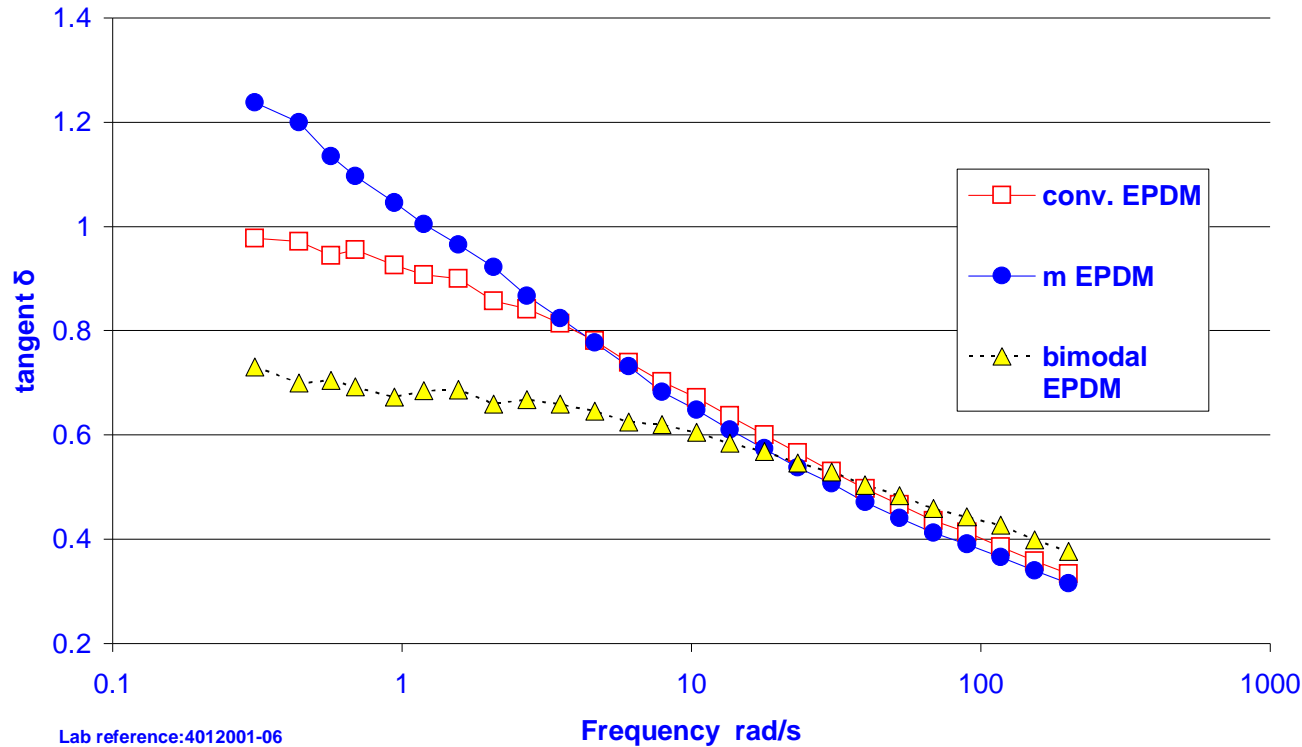


- Metallocene Vistalon have a narrower Molecular Weight distribution than bimodal, close to conventional EPDM



Results: Rheology

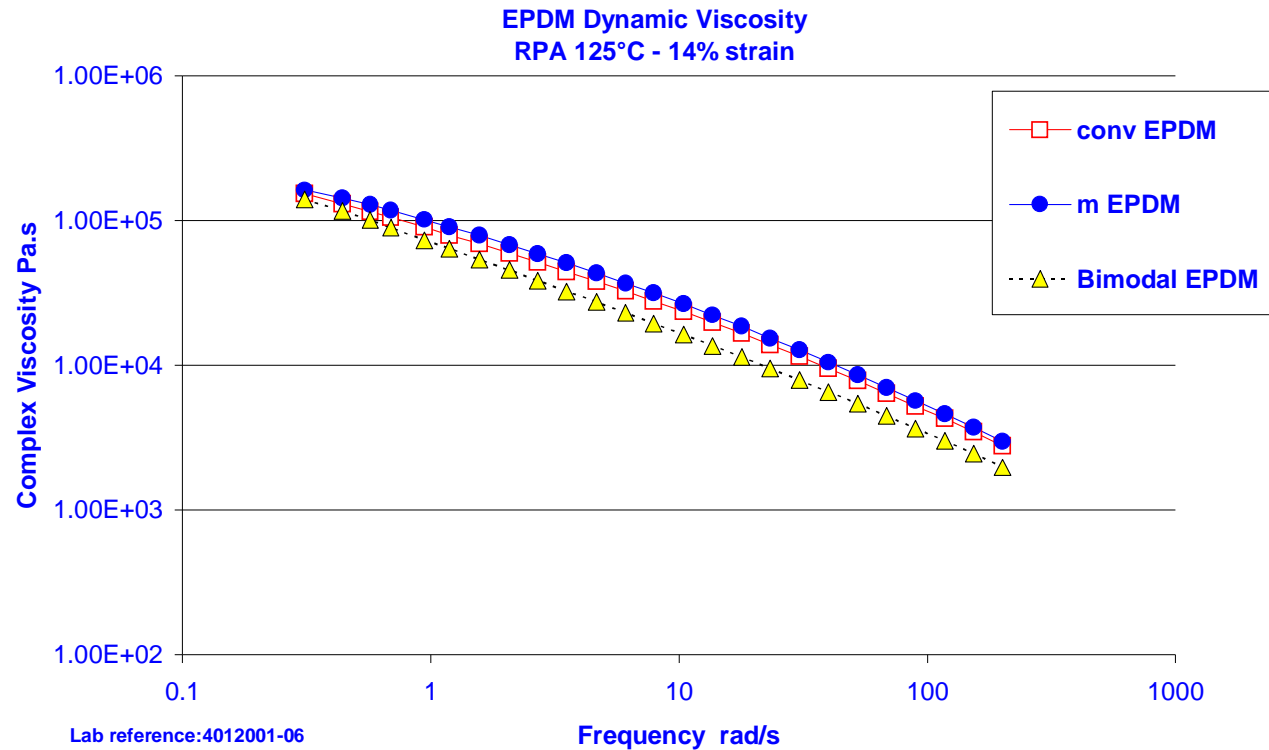
EPDM Elasticity - RPA 125°C, 14% strain



- Metallocene EPDM have a shear sensitive elasticity , in comparison with broader MW distribution EPDM



Results: Dynamic Viscosity

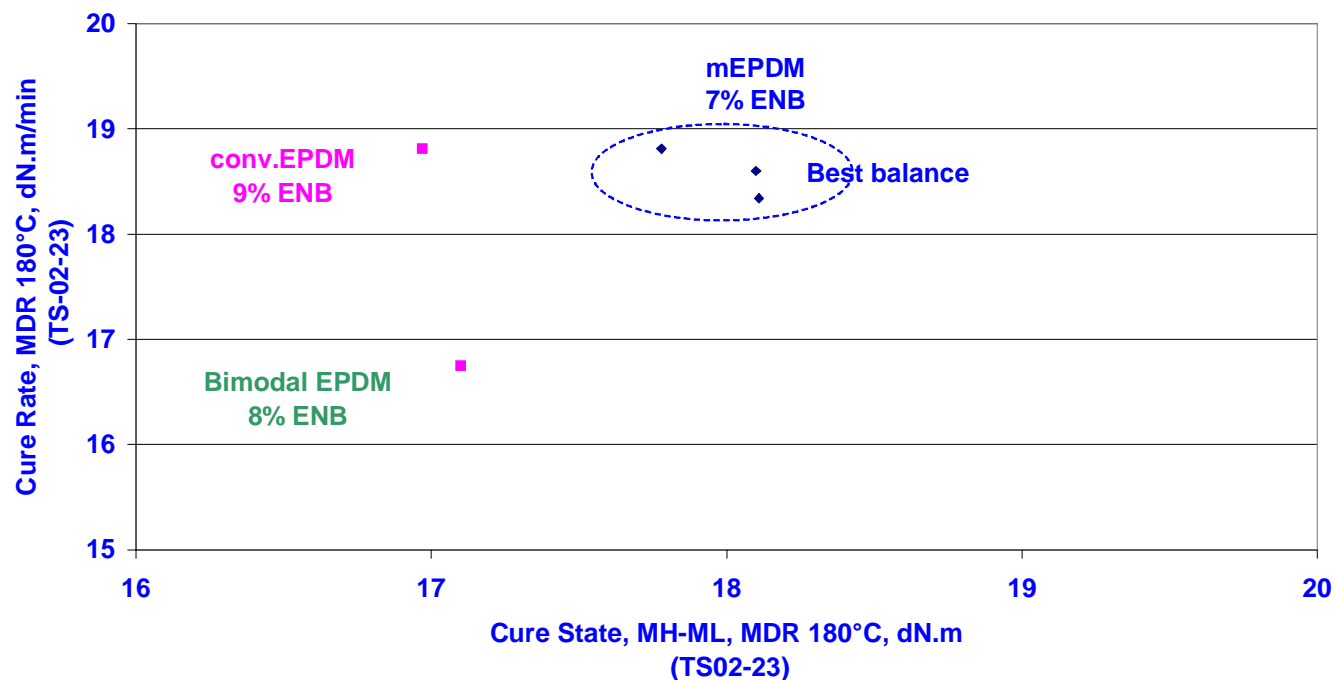


- **Metallocene EPDM have a similar dynamic viscosity than conventional EPDM, higher in comparison with bimodal MWD EPDM**



Results: Cure Properties

Cure Properties Comparison
(Lab. Ref. 20010693)

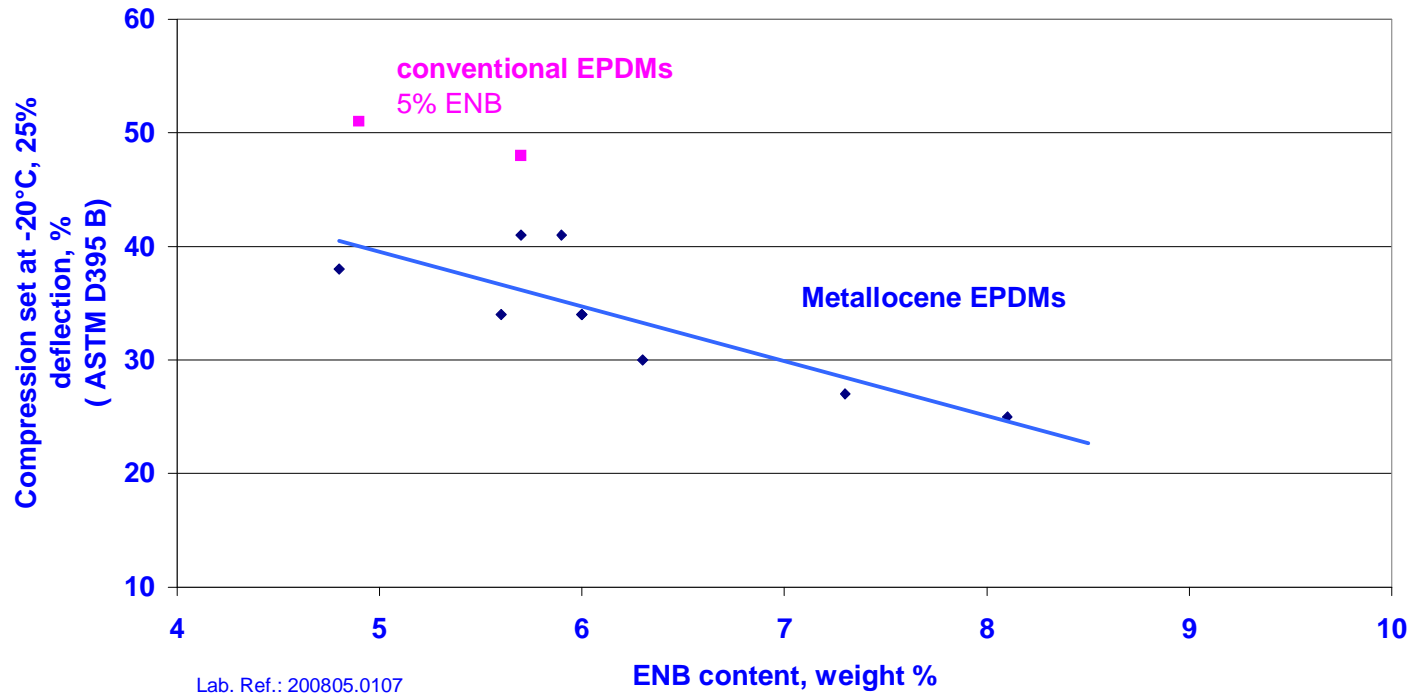


- Metallocene EPDMs offer higher cure rate and state in comparison with conventional EPDM of higher ENB content, thanks to the more uniform monomer incorporation

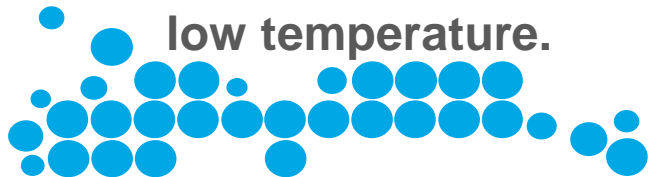


Results: Compression Set

Low Temperature Compression Set

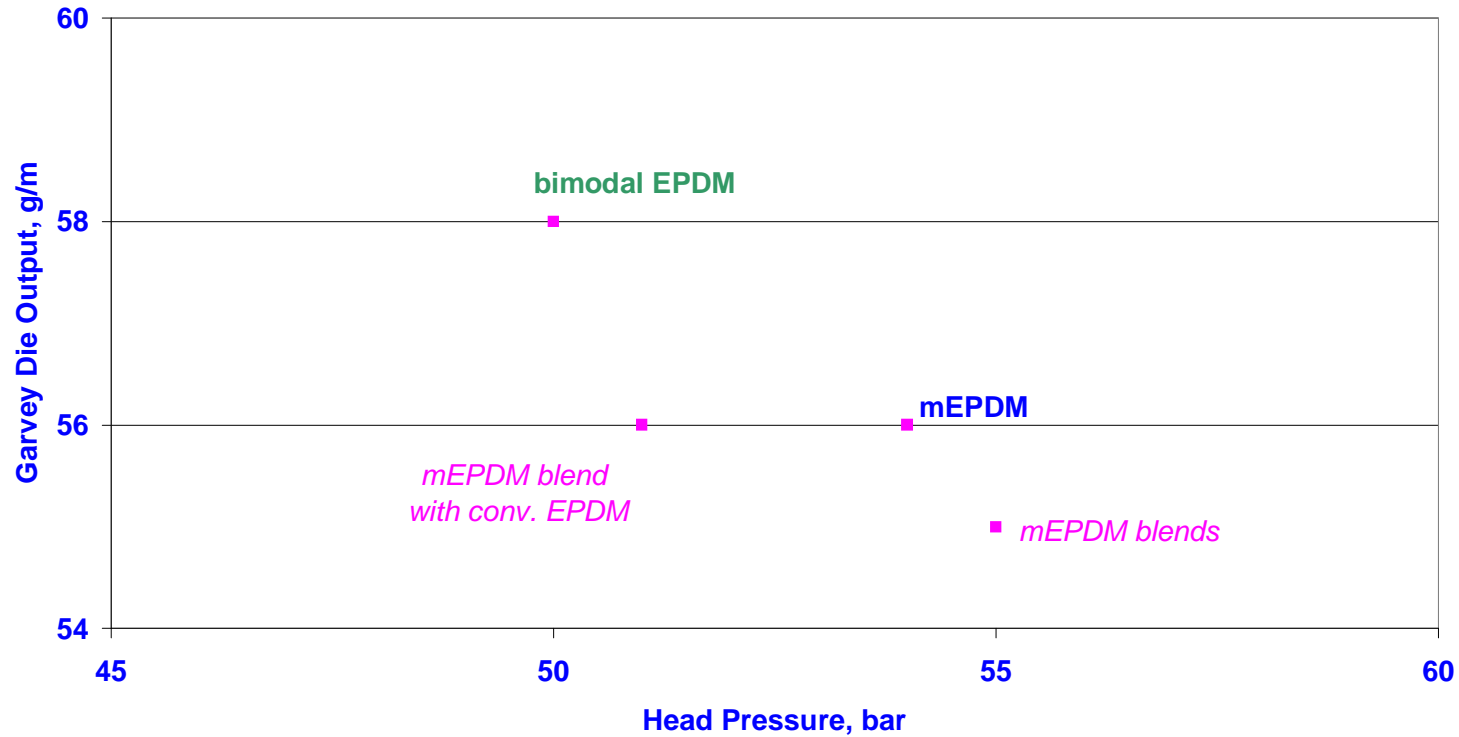


- Metallocene EPDM with a very uniform polymer architecture and monomer distribution offer improved compression set, in particular at low temperature.



Results: Extrusion Performance

Extrusion Performance in Continuous Vulcanization
45mm D extruder - 25 rpm screw speed



- Metallocene EPDM, when properly designed and used in blends, can offer competitive extrusion performance.



Conclusions

- **Metallocene catalysts produce more uniform EPDM polymer architecture**
 - ethylene and propylene sequences
 - molecular weight distribution,so higher cure state and tighter cure rate are obtained.
- **This is a potential source of cost reduction with**
 - lower diene content EPDM's suitable for continuous vulcanization
 - reduced quantity of curatives in the compound
 - improved properties like compression set at high and low temperature.
- **This expansion of properties opens route for improved performance, like in automotive applications**
 - better insulation of sealing system
 - Low temperature flexibility in critical applications like hoses and in brake systems
- **Perspectives:**
 - Further Research and Developments aim at improving the metallocene EPDM design latitude
 - After almost 50 years of existence, single site metallocene catalyst systems are a new source of expansion for EPDM polymers





Thanks for your attention!

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