Plasticizers
–
how they influence the Manufacturing Process

08.12.2011

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Hansen & Rosenthal

Agenda

- Definition of Rubber Oils
- Olasticizers dissolved in Polymers
- Effect of Plasticizers on
  - ⇒ Compound Mooney
  - ⇒ Black Incorporation Time
  - ⇒ Productivity and Energy Consumption
- Oil Injection
- Conclusion
- Bibliography

Definition of Rubber Oils

Oil type	Paraffinic	Relatively naphthenic	Naphthenic	Relativley aromatic	Aromatic	Very aromatic	Highly aromatic
ASTM 225	104 B	104 A	103	102		101	
Carbon structure (ASTM 2140)							
CA [w. %]	<10	<15	0-30	25-40	35-50	50-60	>60
CN [w. %]	20-35	25-40	30-45	20-45	25-40	<40	<25
CP [w. %]	60-75	55-65	35-55	25-45	20-35	<25	<20

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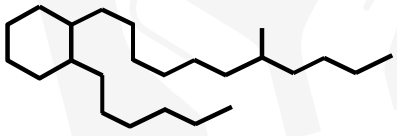

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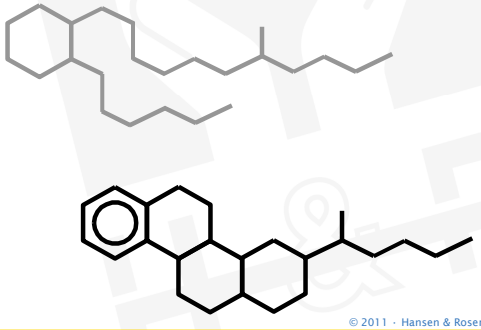

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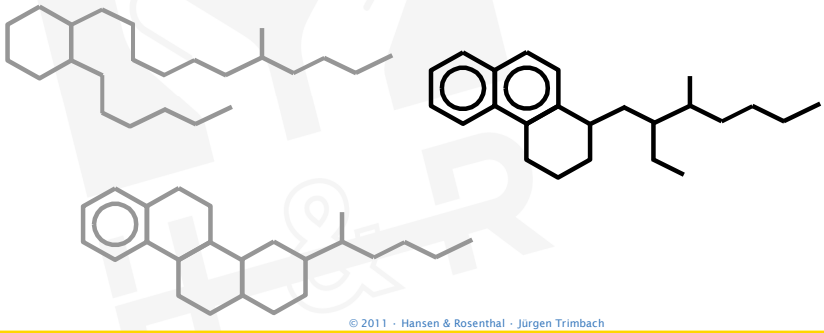

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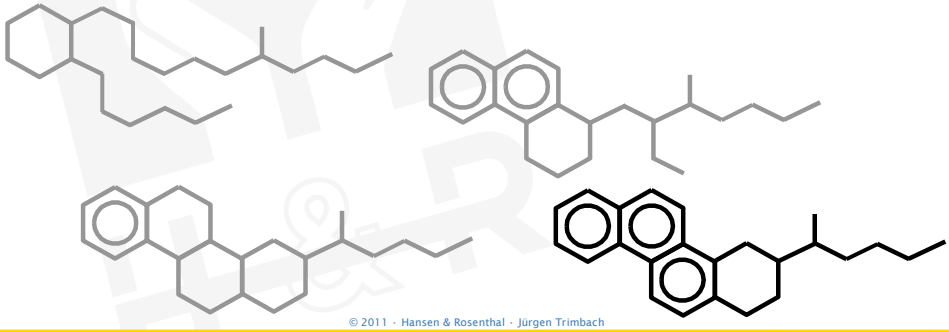

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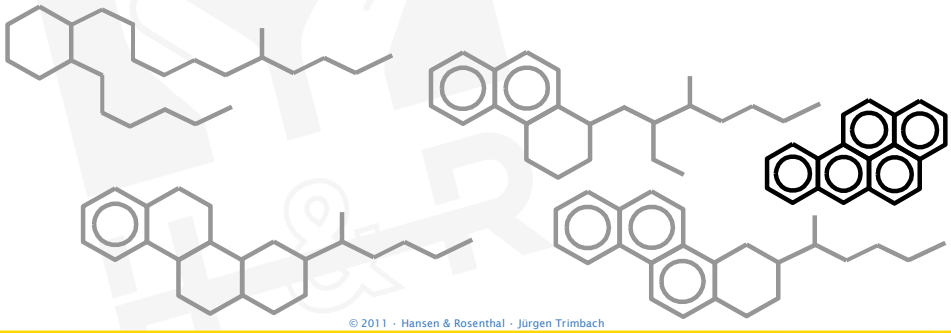
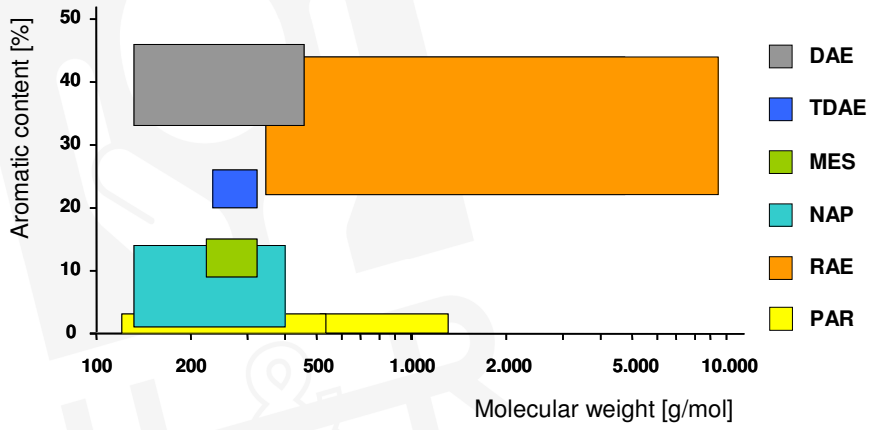


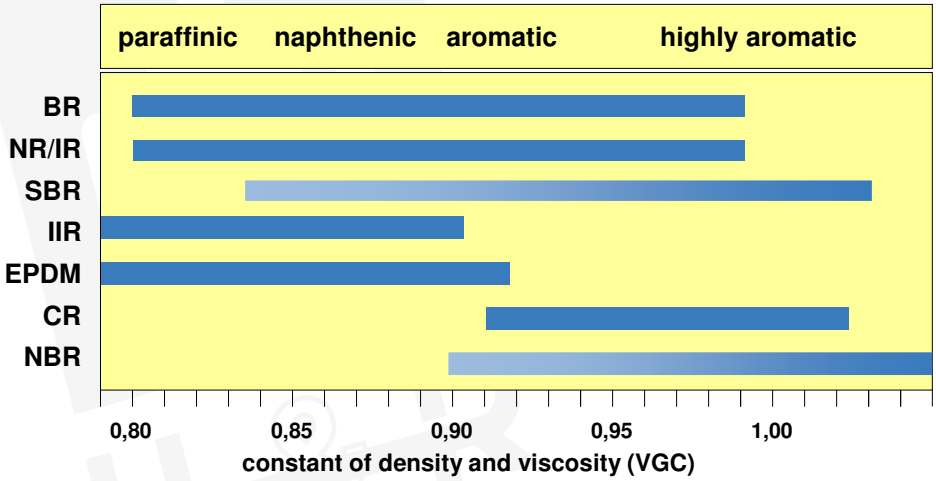
Basics

Definition of Rubber Oils

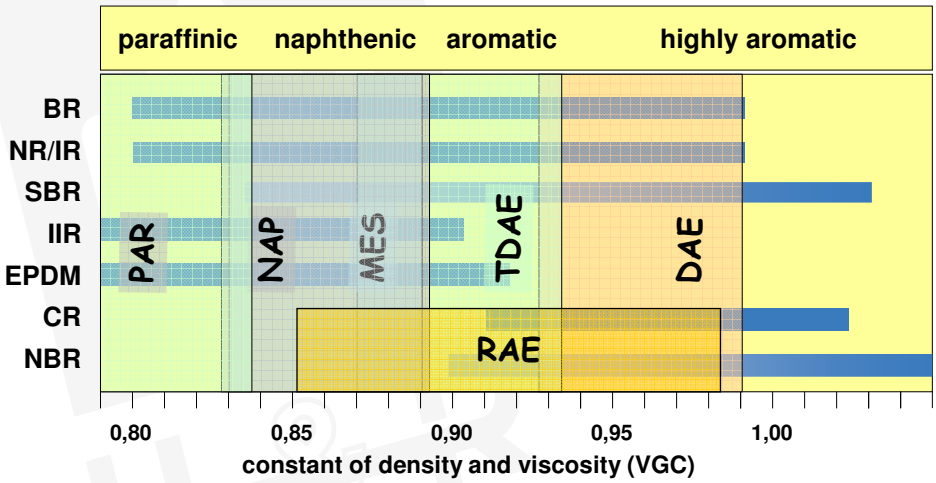


Basics

Rubber and Plasticizers



Rubber and Plasticizers



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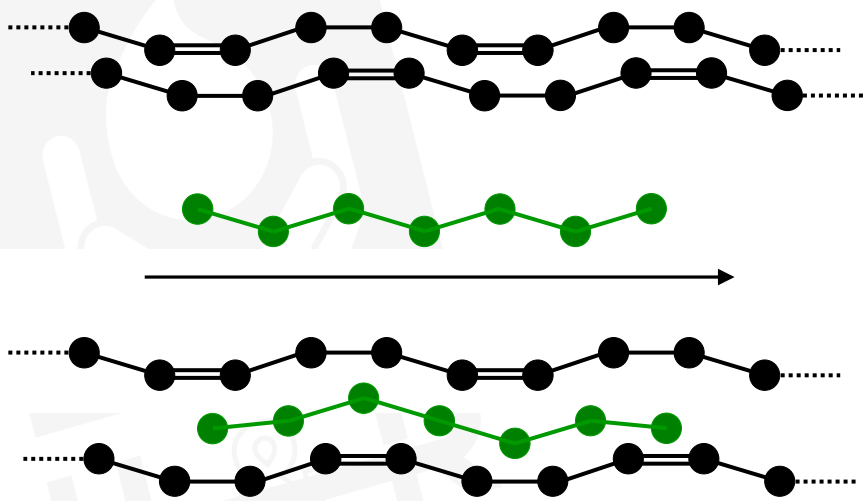

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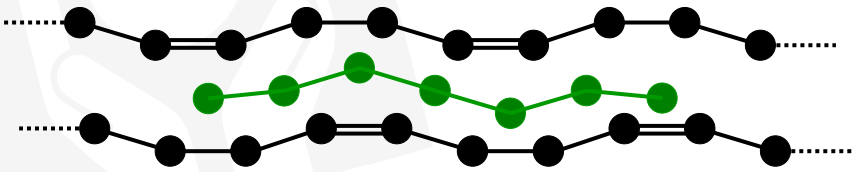

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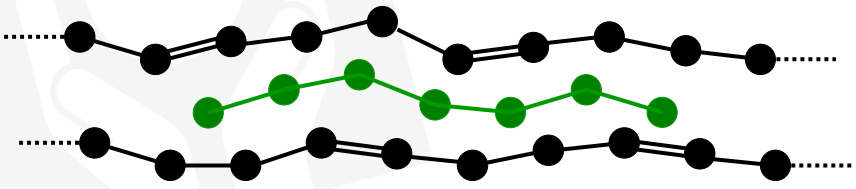
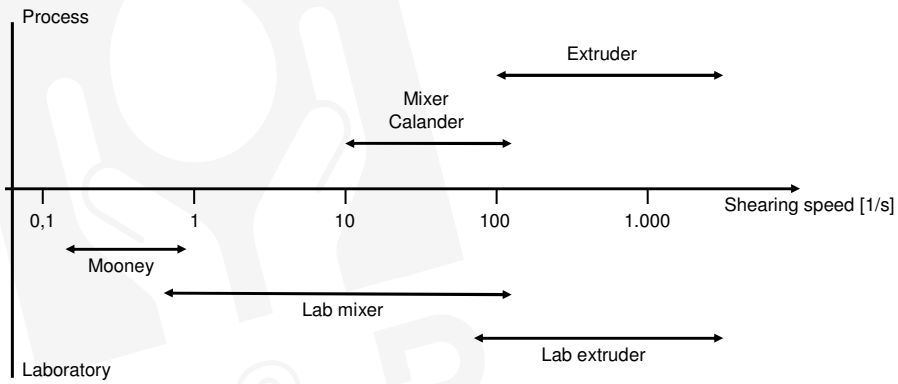


Rubber and Plasticizers

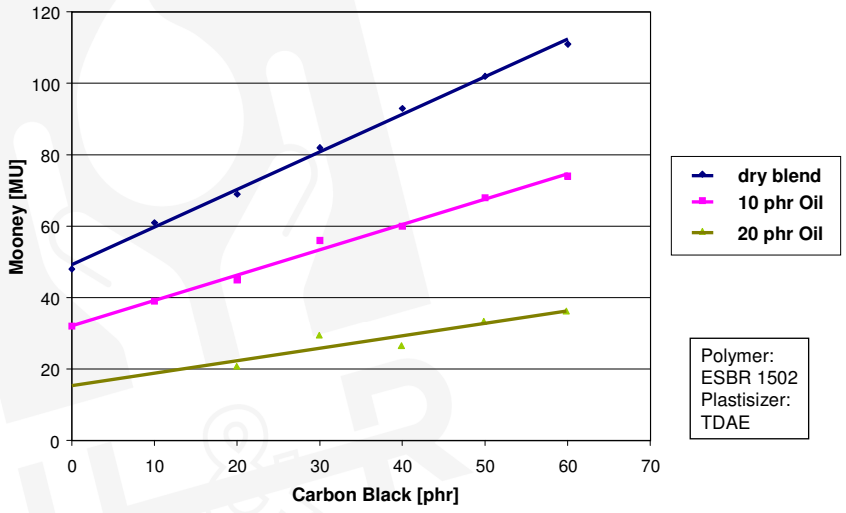
Plasticizers increase the mobility of the polymer chains

- Mooney Viscosity should be reduced
- Demand on Shear Energy should be reduced
- Compounds with high amounts of fillers should be possible
- Total consumption of energy should be reduced

Mixing/Testing - Energy Input

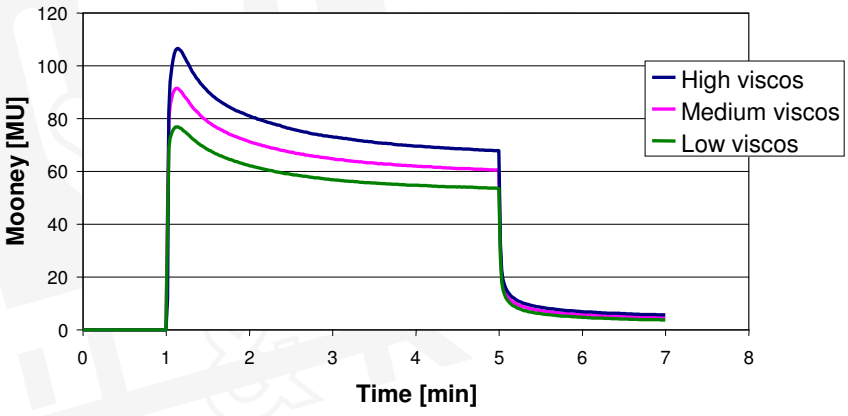


Plasticizer´s Influence on Compound Viscosity



Plasticizer´s Influence on Compound Viscosity

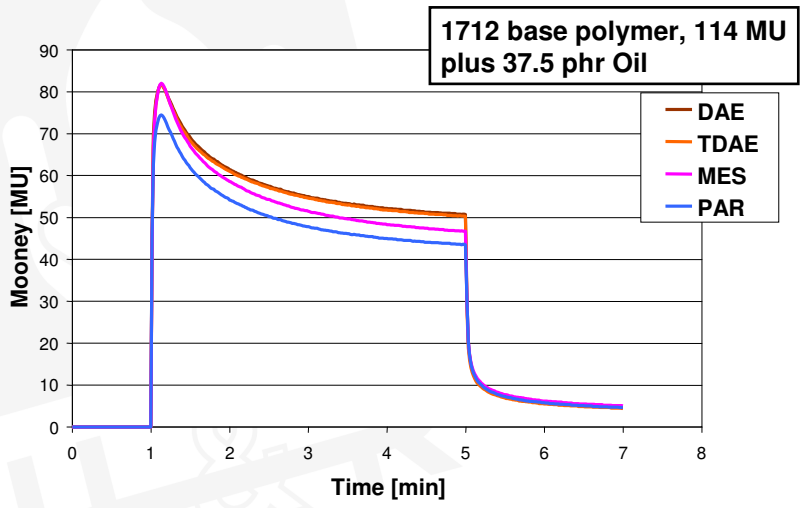
EPDM, Carbon Black,
Paraffinic Oil with different viscosities



Plasticizer Polarity´s Influence on Mooney

Structure	DAE	TDAE	MES	PAR
Aromatic	40	25	12	2
Naphthenic	25	30	29	32
Paraffinic	35	45	59	66
Viscosity @ 100 °C [mm²/s]	24	22	21	21

Plasticizer Polarity´s Influence on Mooney



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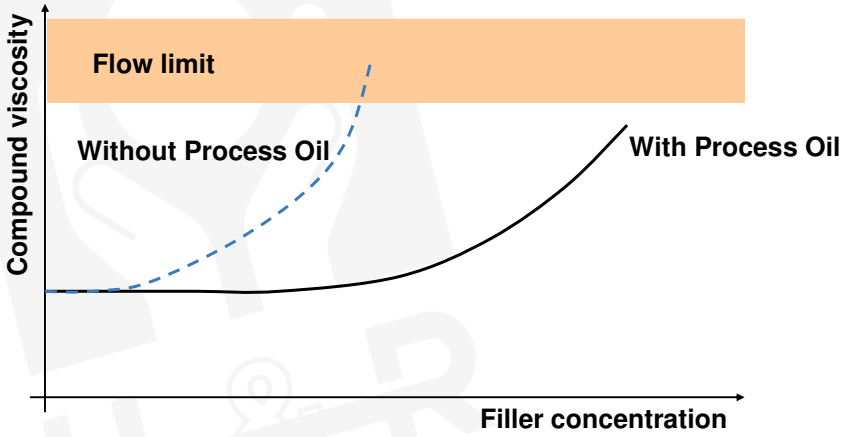
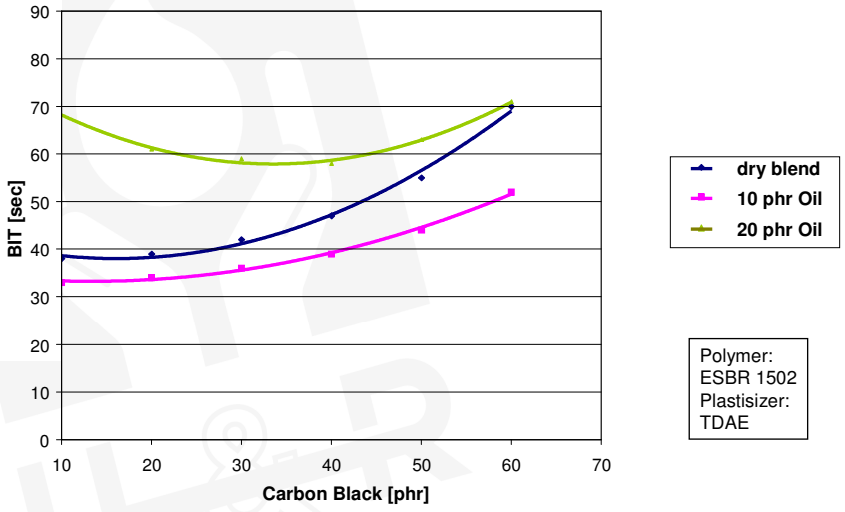
Plasticizer as a Processing Aid



Plasticizer´s Influence on BIT



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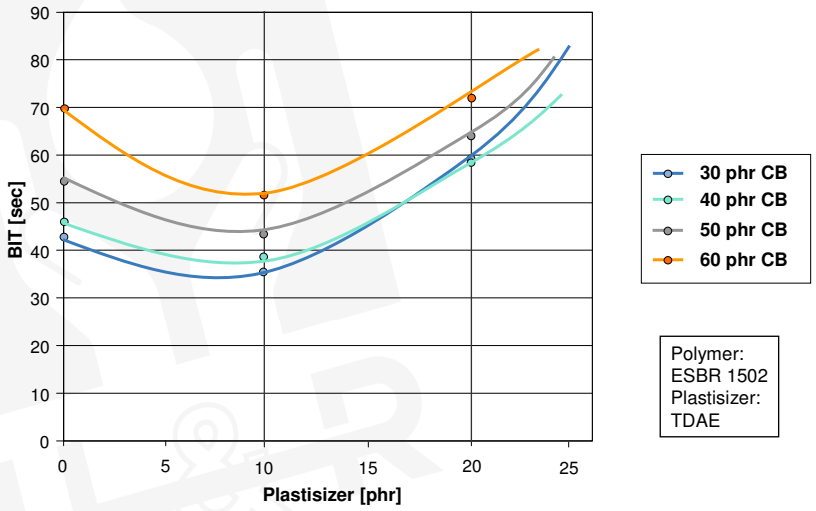


Plasticizer´s Influence on Productivity

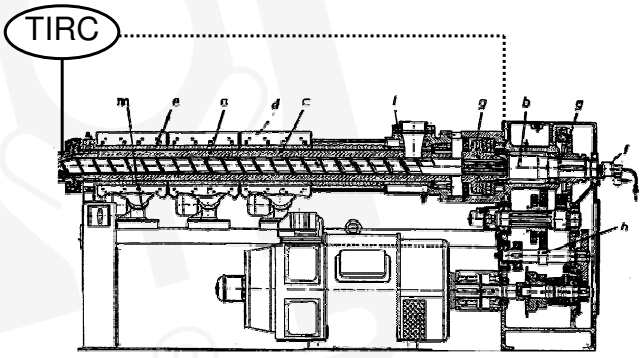
- **Silica tread compound (SSBR/HC-BR/NR, HD-Silica)**
- **Plasticizers: DAE, TDAE, MES, NAP, RAE**
- **450 l Banburry**

Plasticizer´s Influence on Productivity

Properties	Test Method	Unit	DAE	MES	TDAE	RAE	NAP
Density @ 15°C	DIN 51 757	kg/m³	990	915	950	980	925
Refractive index nD20°C	DIN 51 423	-	1,56	1,51	1,53	1,55	1,51
Kin. viscosityt @ 100 °C	DIN 51 562	mm²/s (cSt)	26	16	19	60	19
Sulfur	DIN 51 400	W.%	1,2	0,5	0,8	1,4	0,1
Aniline point	DIN ISO 2977	°C	41	97	68	72	96
VGC	DIN 51 378		0,94	0,84	0,89	0,90	0,85
C distribution:	DIN 51 378						
CA		W.%	40	15	25	34	13
CN		W.%	25	27	30	28	33
CP		W.%	35	58	45	38	54
DMSO-Extract	IP-346	W.%	22	< 2.9	< 2.9	4.2 (n.a.)	< 2.9
Benzo(a)pyrene	GC/MS	ppm	17	<1	<1	<1	<1
8 critical PCAs	GC/MS	ppm	320	<10	<10	<10	<10
Glass transition point	BP/GRE 208TA2	°C	-38	-58	-49	-45	-56

Plasticizer´s Influence on Productivity

T: 110 °C +/- 2 K



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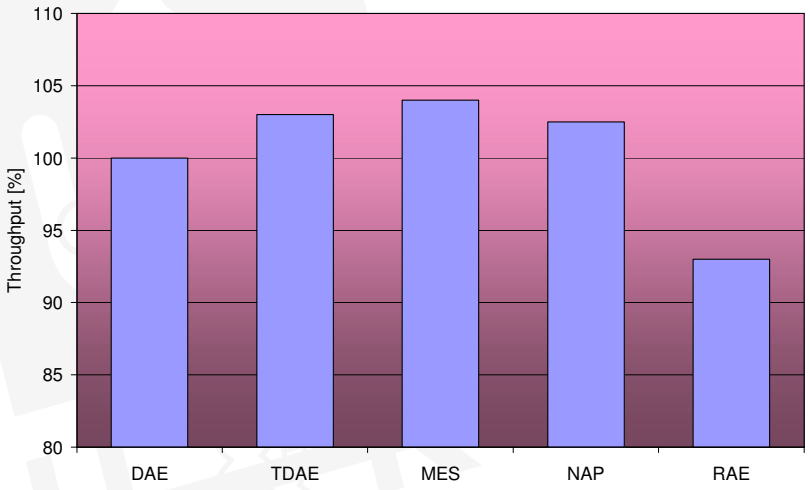
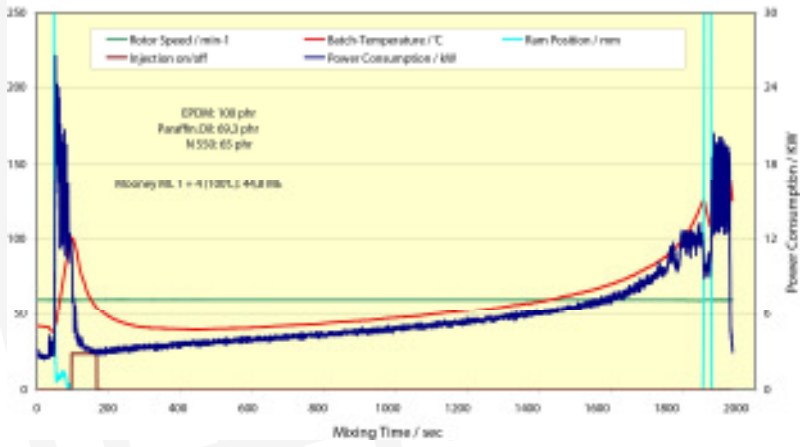
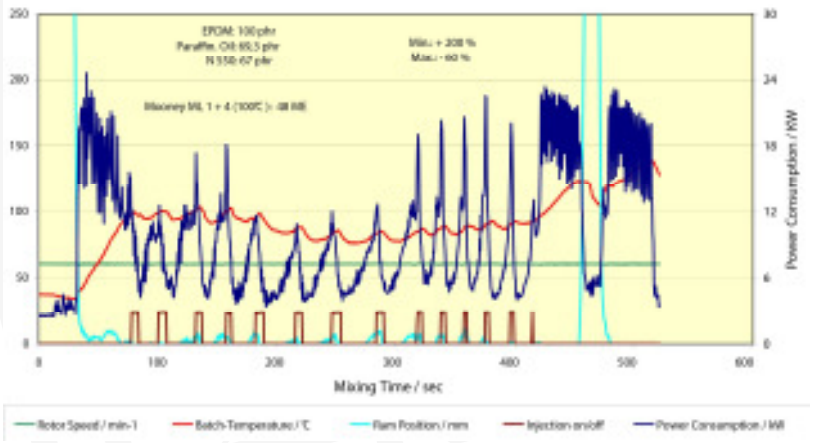


Direct Oil Injection



Controlled Oil Injection



Conclusion

We could see that Plasticizers

- Reduce the Mooney Viscosity
- Allow Compounds with high amounts of fillers
- Reduce the Demand on Shear Energy
- Reduce the total consumption of energy
- Increase the productivity

Last but not least

Thank you for your attention!
Do you have any question?

Bibliography

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