

Solubility Study of Curatives in Various Rubbers

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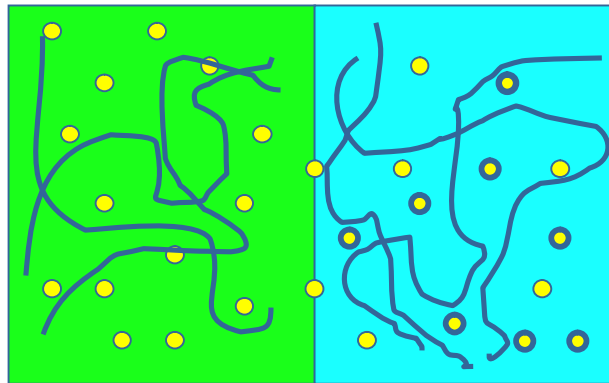


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Introduction



Dissimilar Rubber Blends

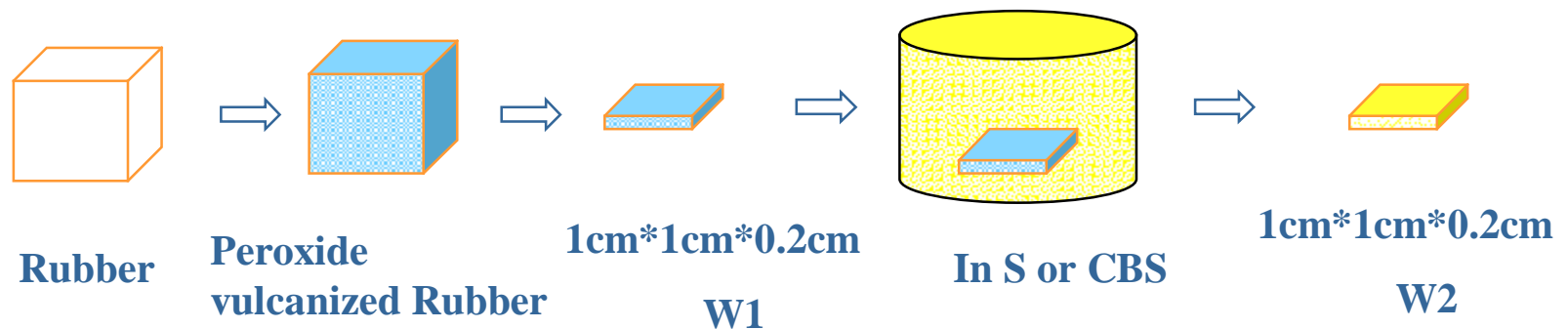
Aim of the study

- **To obtain the solubility data of curatives in various rubber.**



- **To predict the dispersion of curatives in rubber blends**

Experimental



$$\text{Weight increase of S/CBS} = (W2 - W1) / W1 * 100\%$$

Experimental

General formulation for gum rubber compounds.

Component	Amount (phr)		
SBR	100	0	0
NBR	0	100	0
EPDM	0	0	100
ZnO	5	5	5
Stearic acid	2	2	2
Dicumyl peroxide (40%) *	1	4.8	6.25

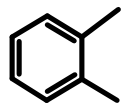
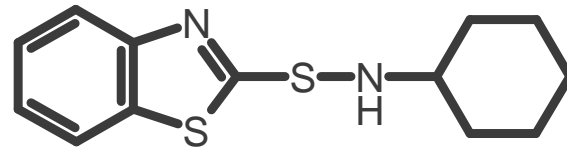
*PERKADOX BC-40B



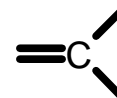
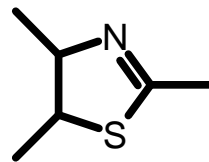
Calculation

Ø Method of Hoftyzer-Van Krevelen-group contribution

CBS



ring



Calculation

$$d_d = \frac{\sum F_{di}}{\sum V_i}$$

$$d_p = \frac{\sqrt{\sum F_{pi}^2}}{\sum V_i}$$

$$d_h = \frac{\sqrt{\sum E_{hi}}}{\sum V_i}$$

F_{di} F_{pi} E_{hi} V_i is based on functional group

$$d^2 = d_d^2 + d_p^2 + d_h^2$$

$$\overline{\Delta d} = [(d_{d1} - d_{d2})^2 + (d_{p1} - d_{p2})^2 + (d_{h1} - d_{h2})^2]^{1/2}$$

$$\Delta\delta < 5 \text{ (J}^{1/2}/\text{cm}^{3/2}\text{)}$$

Results-- Calculated solubility parameters

	EPDM	SBR	NBR
δ_d	16.4	17.1	16.9
δ_p	0	0.4	7.2
δ_h	0	0	3.7

Results-- Calculated solubility parameters

	S₈	OT20	CBS	DCBS	MBT
δ_d	33.1	22.0	20.4	21.8	22.5
δ_p	0	0	4.0	2.2	7.5
δ_h	0	0	6.3	6.2	6.8



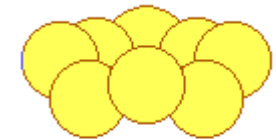
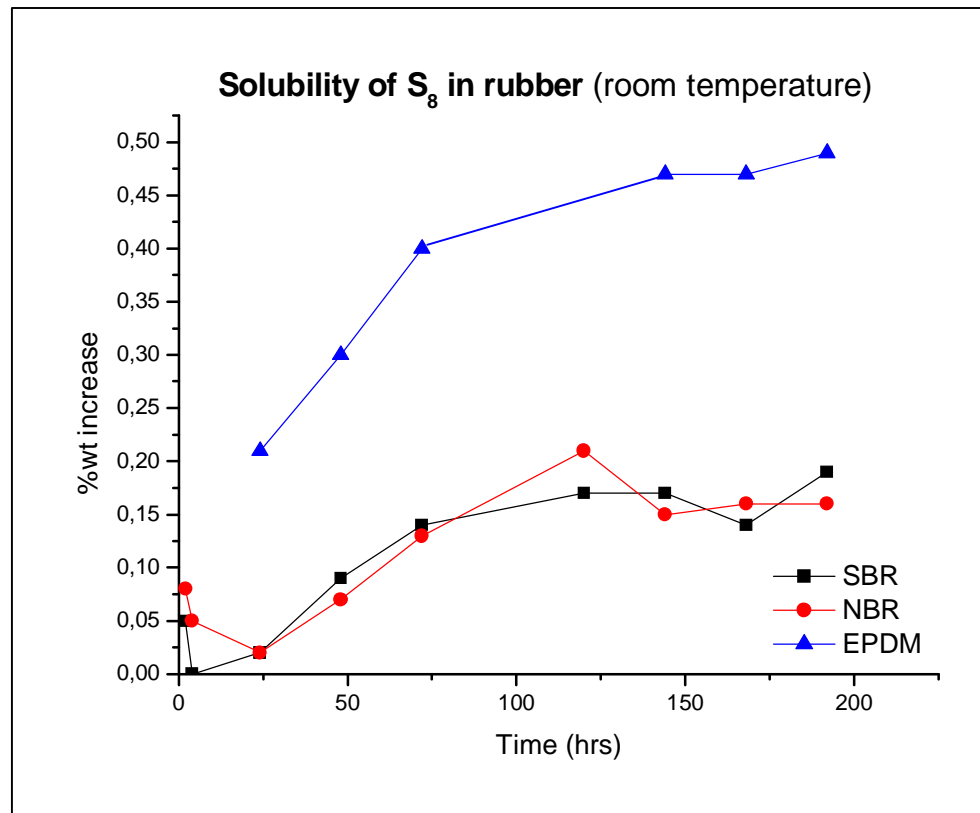
Non-polar






Polar



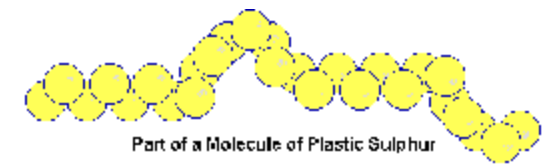
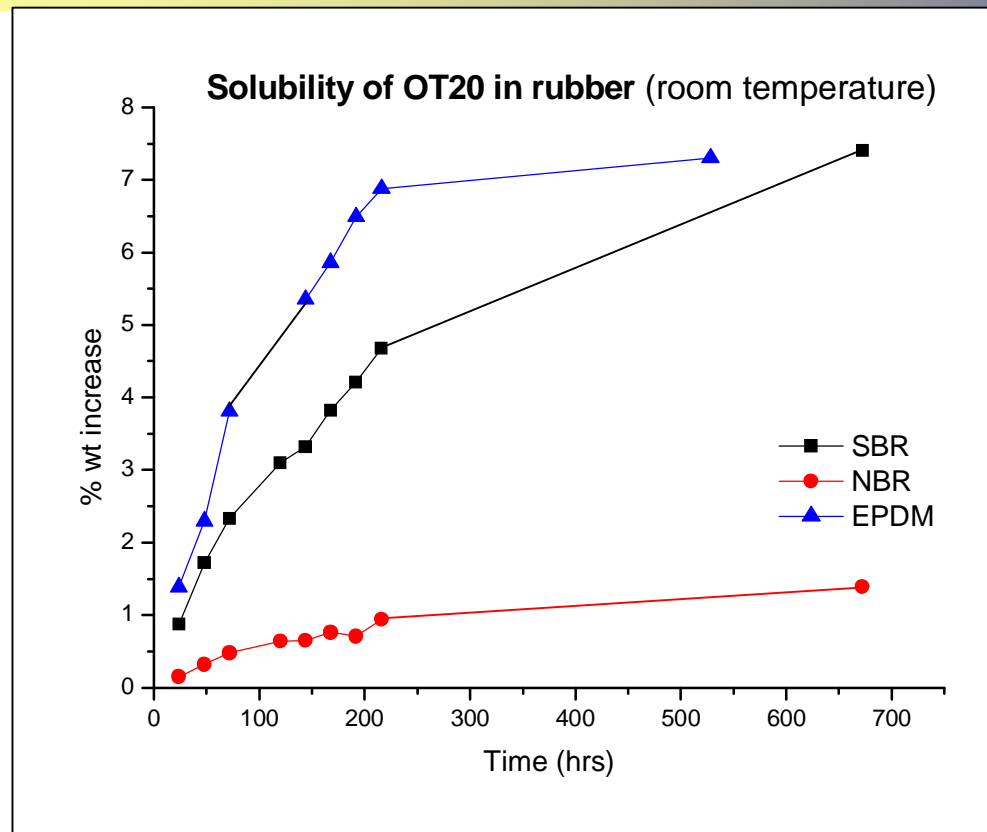
Results– Mutual solubility






The S_8 molecule

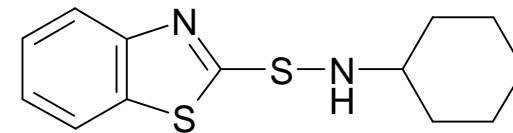
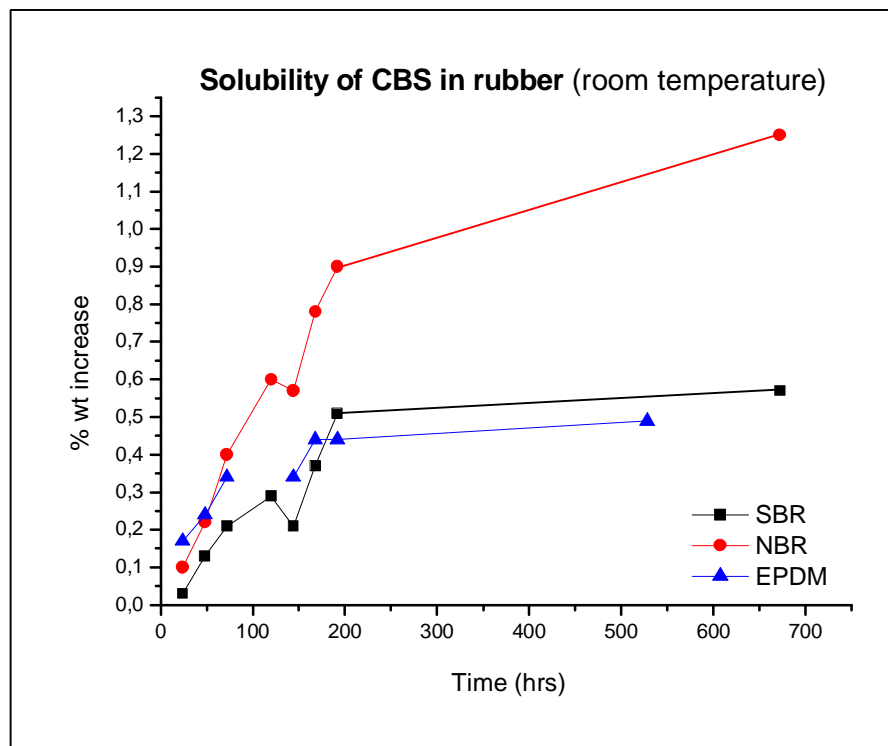
$\overline{\Delta\delta}$	SBR 	NBR 	EPDM 
S_8	16.0	18.1	16.8





Results– Mutual solubility



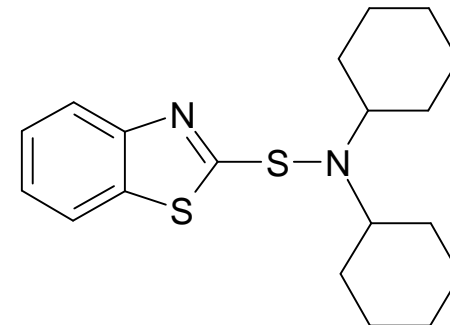
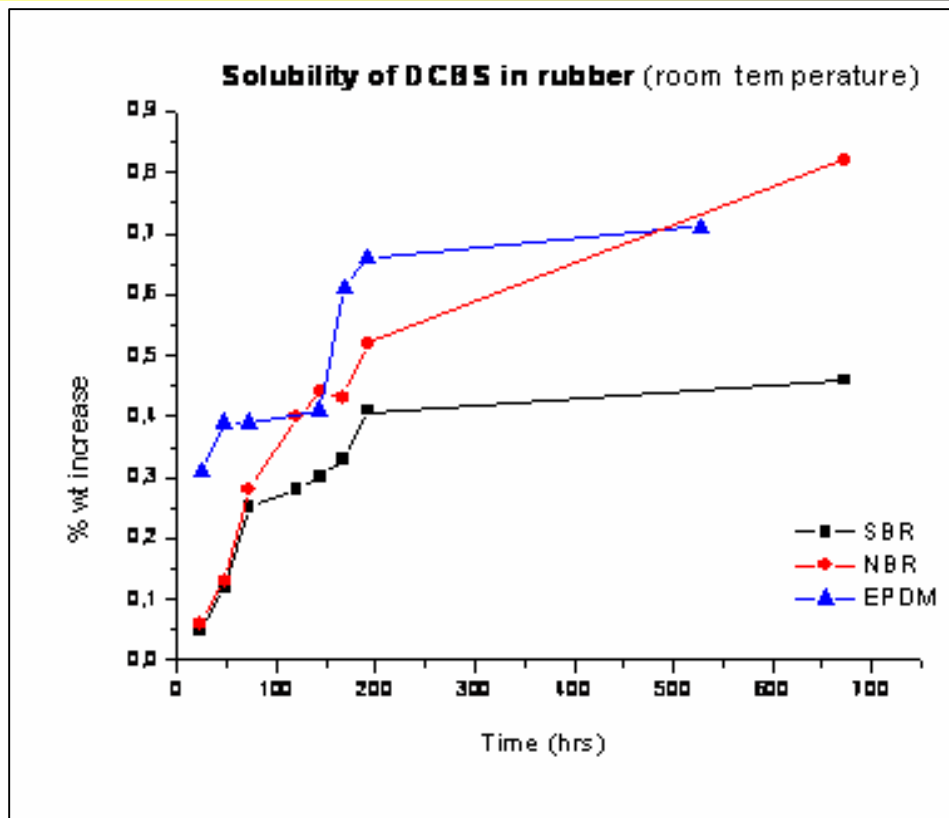
$\overline{\Delta\delta}$	SBR 	NBR 	EPDM 
OT20	4.9	9.6	5.6




Results– Mutual solubility



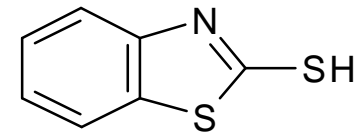
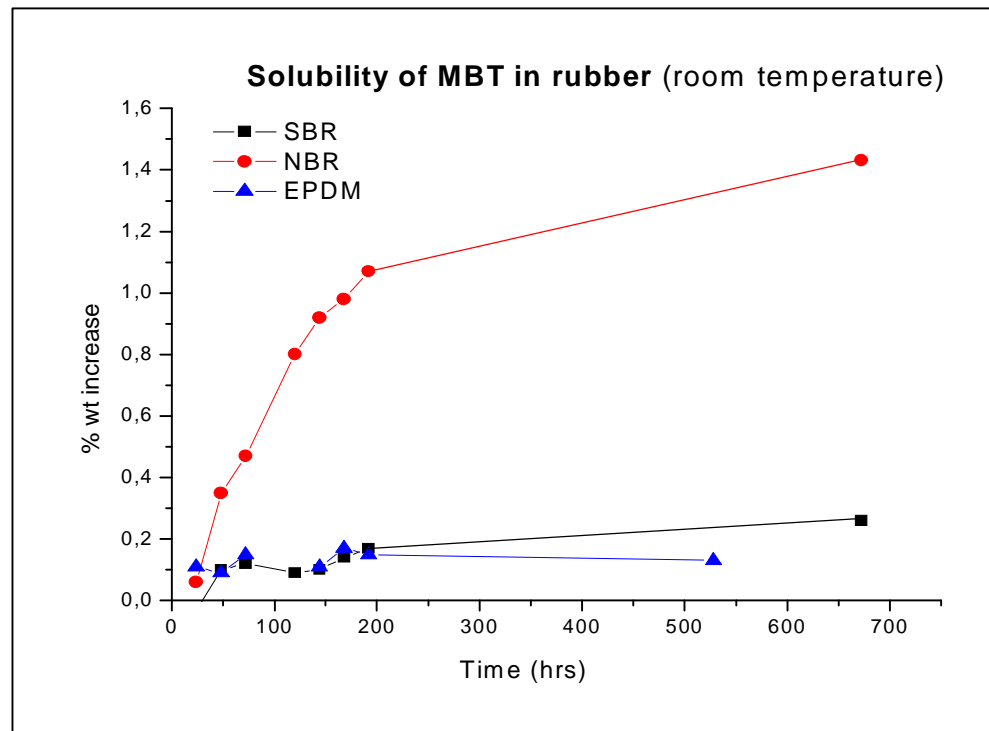
	SBR 	NBR 	EPDM 
CBS	8.0	5.4	8.5





Results– Mutual solubility



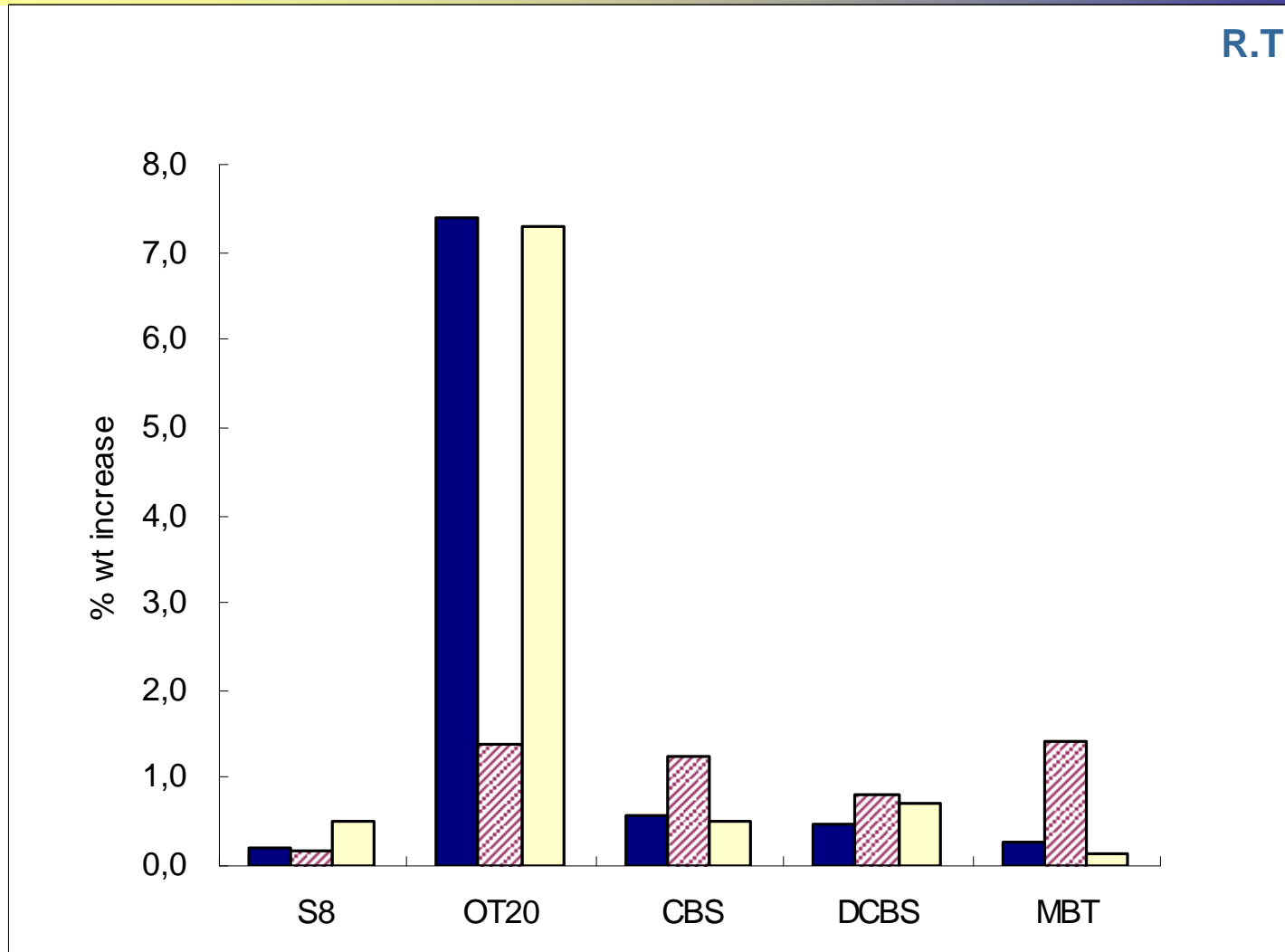
	SBR 	NBR 	EPDM 
DCBS	8.0	7.5	8.5

Results– Mutual solubility

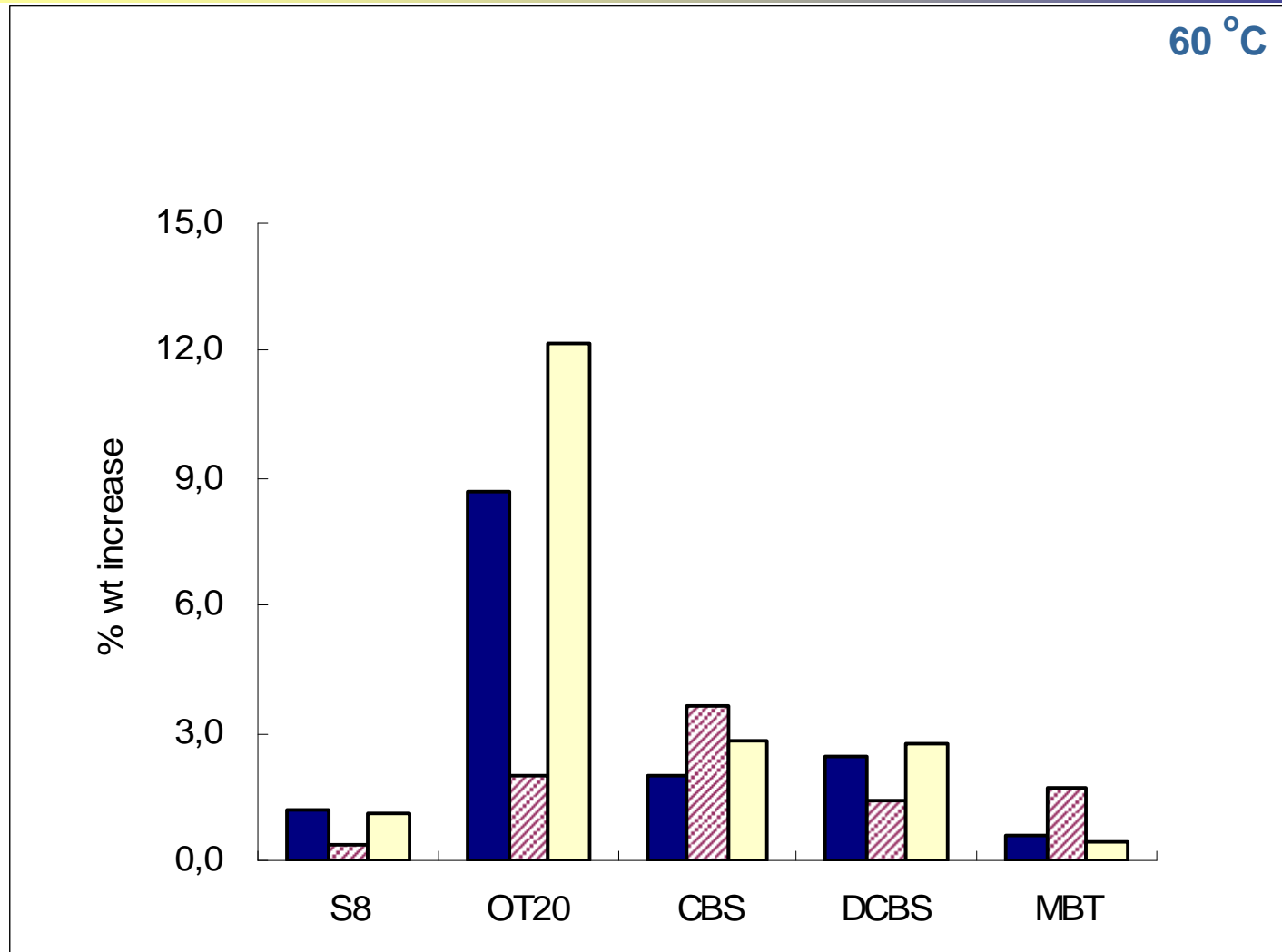


	SBR 	NBR 	EPDM 
MBT	11.2	6.5	11.8

Results– Overview solubility of accelerators

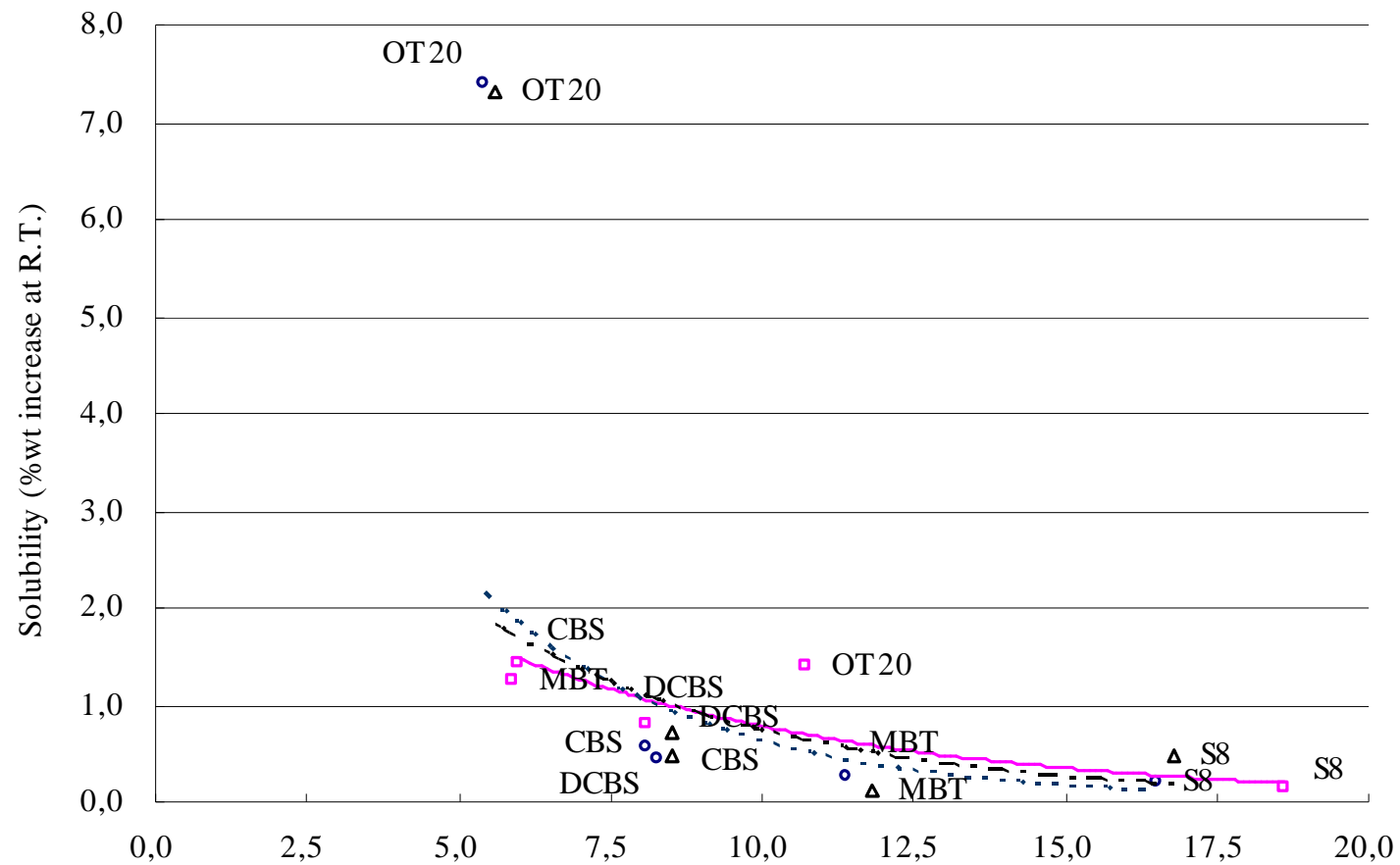


Results– Overview solubility of accelerators

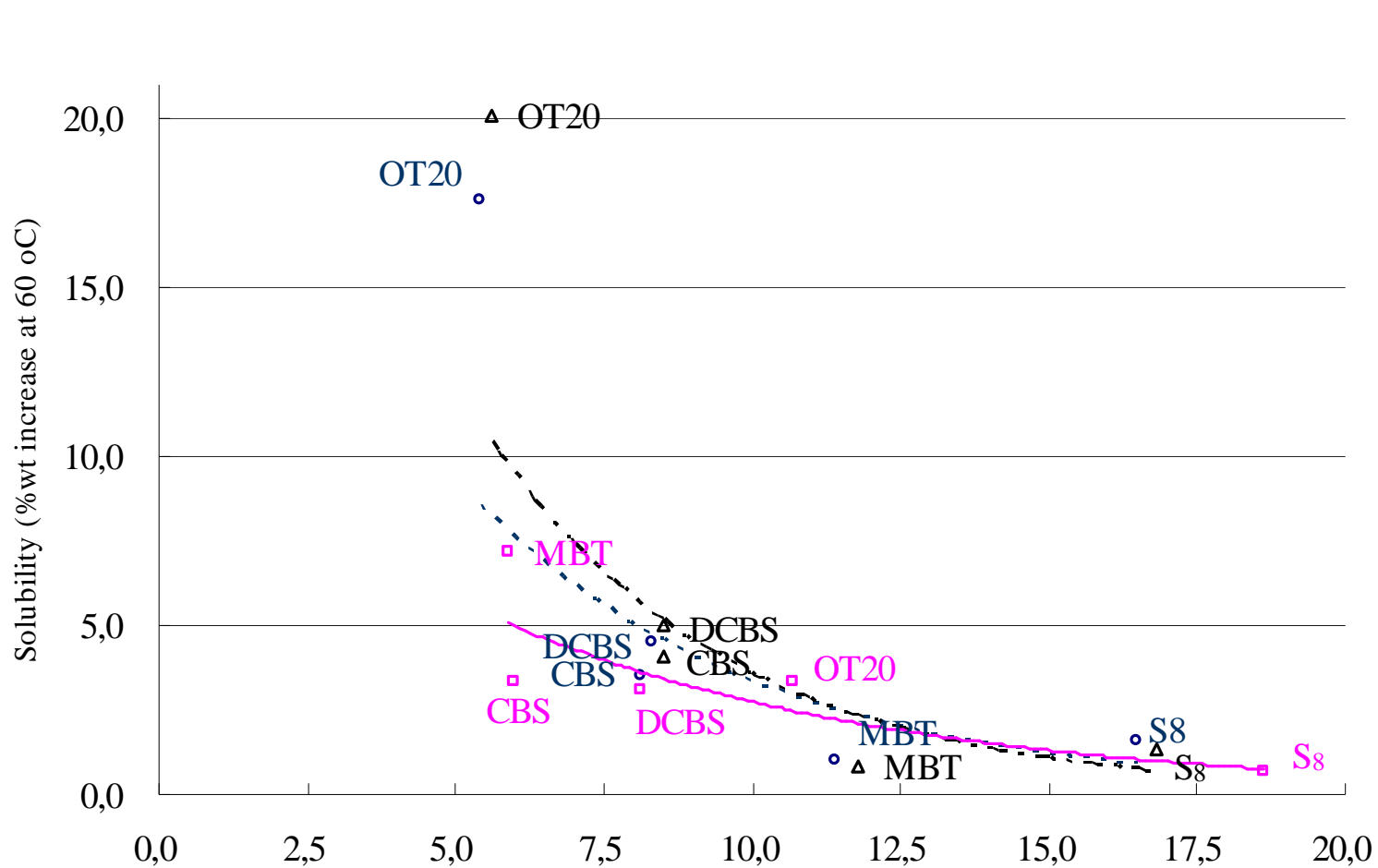


Results– Correlation

R.T



Results– Correlation



Summary

∅ The theoretical results correlate with the experimental data.

∅ Solubility preference:

Sulfur: SBR>EPDM>>NBR

∅ OT20: EPDM>SBR>>NBR

CBS: NBR>>SBR>EPDM

MBT:

DCBS: SBR>EPDM>NBR

∅ The structure of rubber polymer should be taken into account in the calculation

Thanks!

Questions and comments?

