

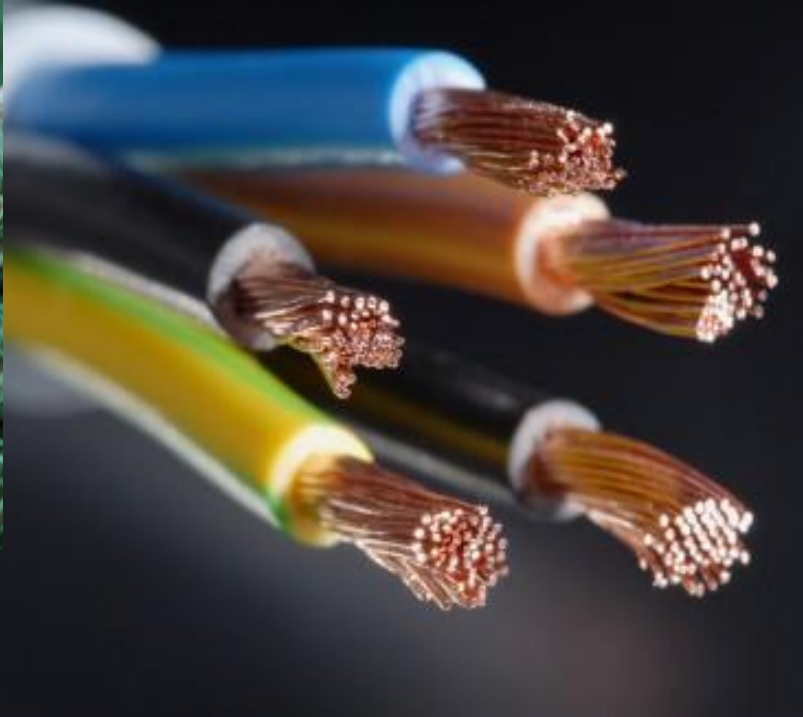


Plasticizer compositions based on Oxoviflex

dr inż. Agnieszka Abramowicz
mgr inż. Marcin Kumosiński

INDUSTRIAL CHEMISTRY RESEARCH INSTITUTE, WARSAW







Advantages

- ✓ Availability of raw materials
- ✓ Low manufacturing cost
- ✓ Weather resistance
- ✓ Resistance to corrosion, chemicals, oils
- ✓ Flame resistance (flame resistant, retardant, self-extinguishing)
- ✓ Good insulating properties
- ✓ High barrier properties

Disadvantages

- ✓ **Low thermal stability**
- ✓ Necessity to use the expensive processing aids:
 - thermal stabilizers e.g. Ba/Zn, Ca/Zn, organotin ones
 - impact modifiers, e.g. terpolymer methyl methacrylate-butadiene-styrene (MBS)
 - plasticizers
 - lubricants

Since 2015 the common project of:



Azoty Group, Nitrogen Works Kedzierzyn
Industrial Chemistry Research Institute, Warsaw

focused on:

Elaboration of new processing aids for PVC based on mineral modifiers and plasticizers manufactured in Grupa Azoty ZAK S.A.



Application of Oxoviflex plasticizer to modification of inorganic filler showing platelet-tubular structure will make possible:

- Reduction of amount or elimination the use of plasticizer in the step of blend preparation
- **Lower flammability**
- Mechanical properties improvement



- PVC-S67 -100 phr
- **PLASTICIZER DEHT-10** phr
- STABILIZER
- IMPACT MODIFIER
- FLOW MODIFIER
- INTERNAL & EXTERNAL LUBRICANTS
- FILLERS (TITANIUM DIOXIDE, CALCIUM CARBONATE)
- **MODIFIER (with plasticizer)**



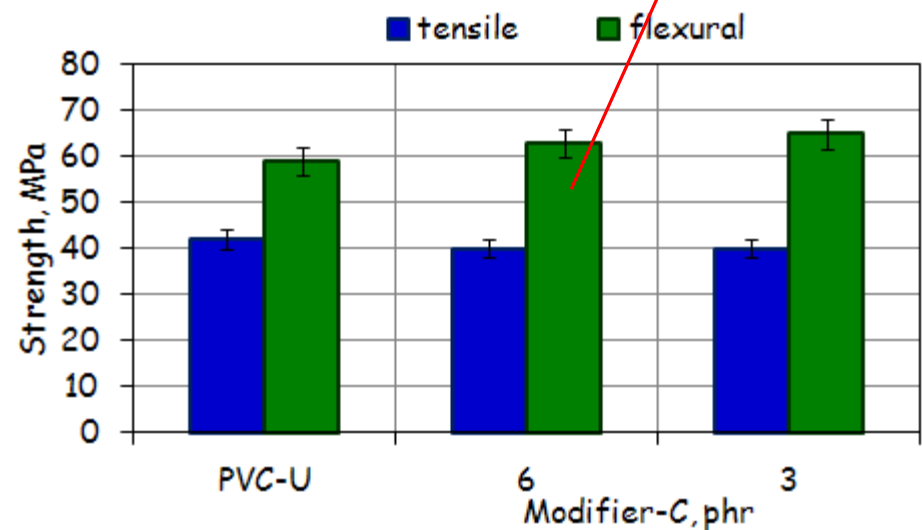
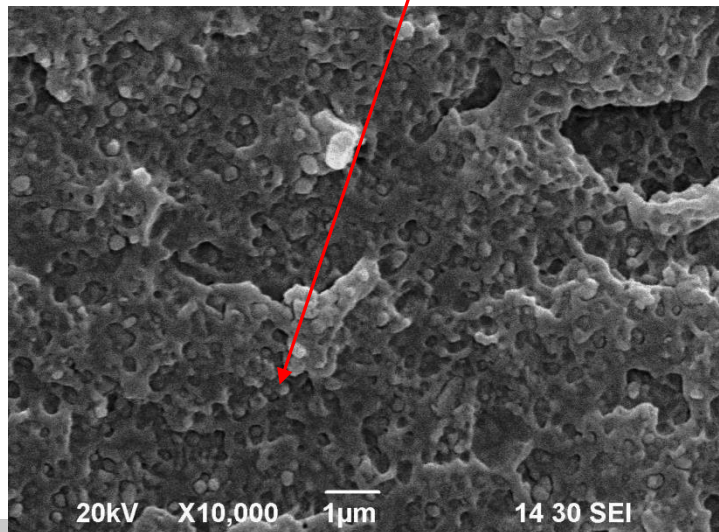
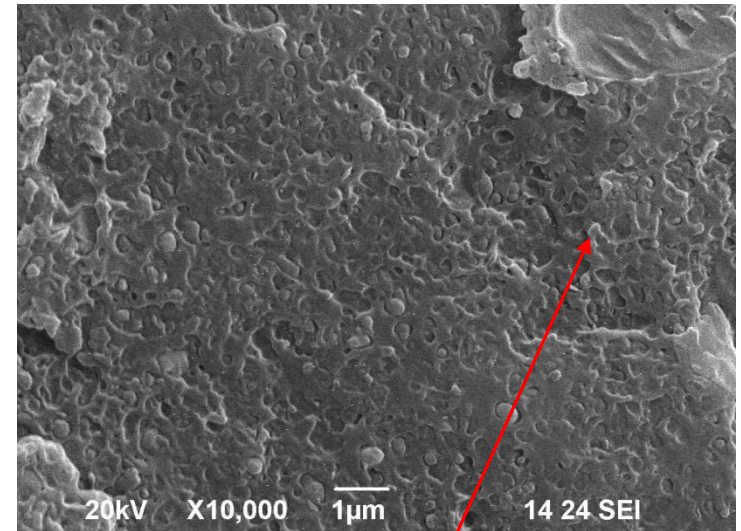
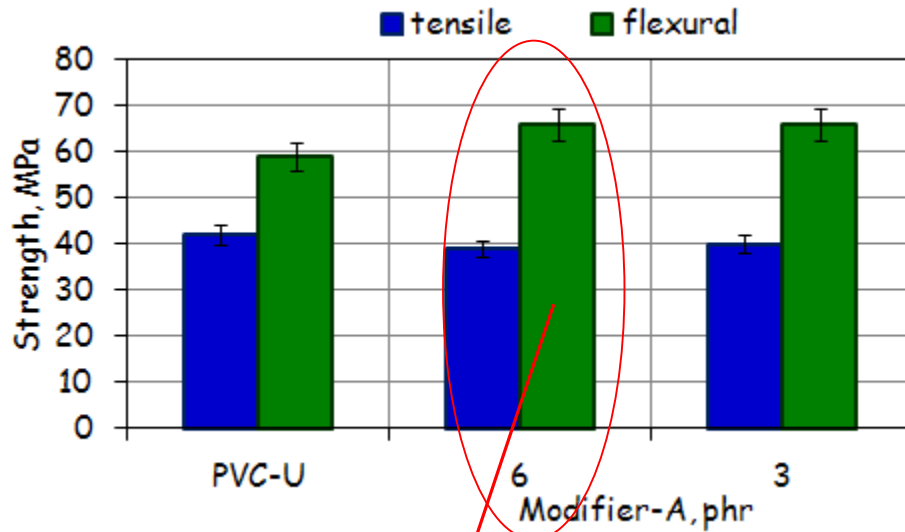
- ✓ Counterrotating twin screw extruder
Brabender (Plasti - Corder PL 2100)

Parameters:

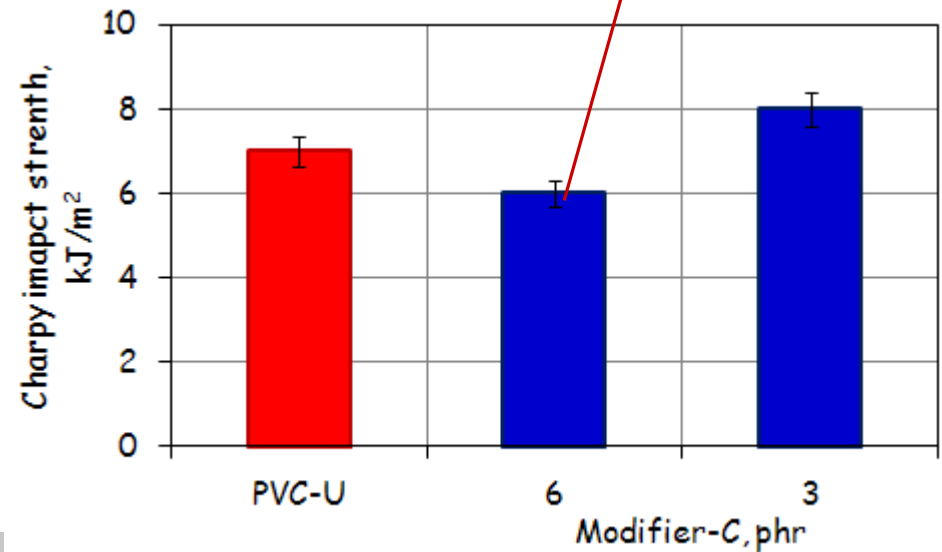
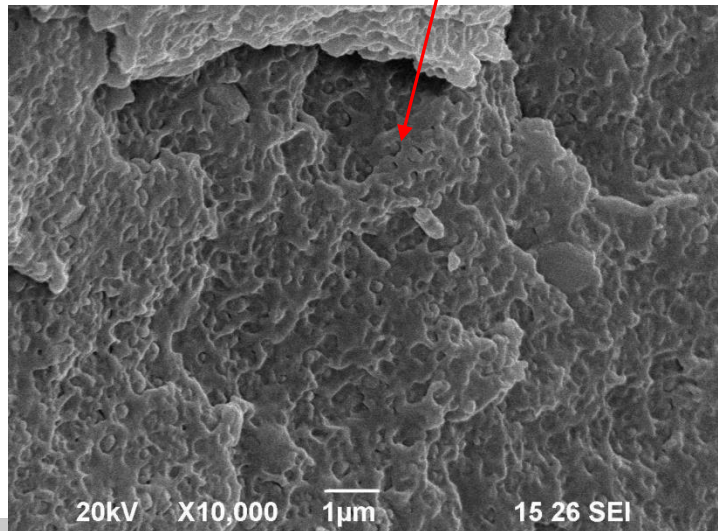
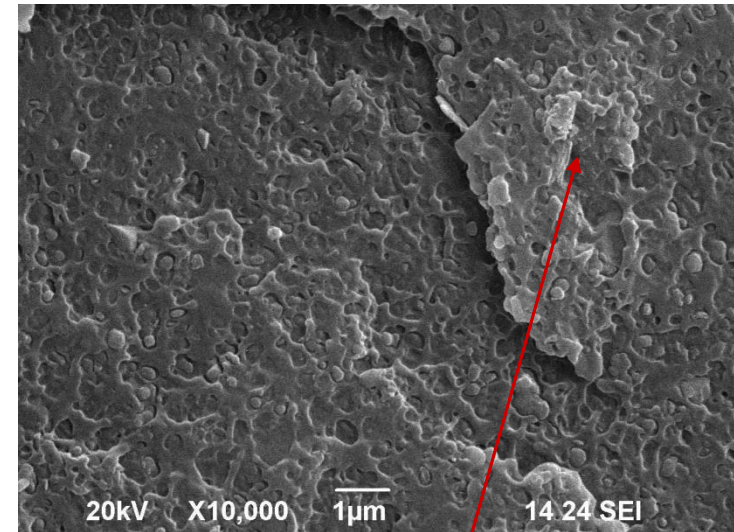
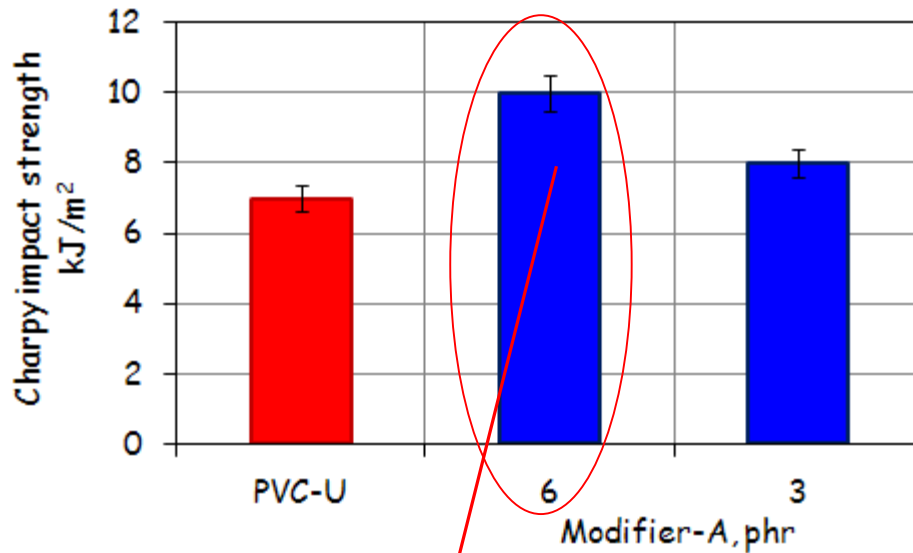
$D = 42 \text{ mm}$
 $L/D = 6$

Process parameters for PVC-U composites	T (°C)	Rotational speed (min ⁻¹)	Yield (kg/h)
	165 - 185	35	5.0

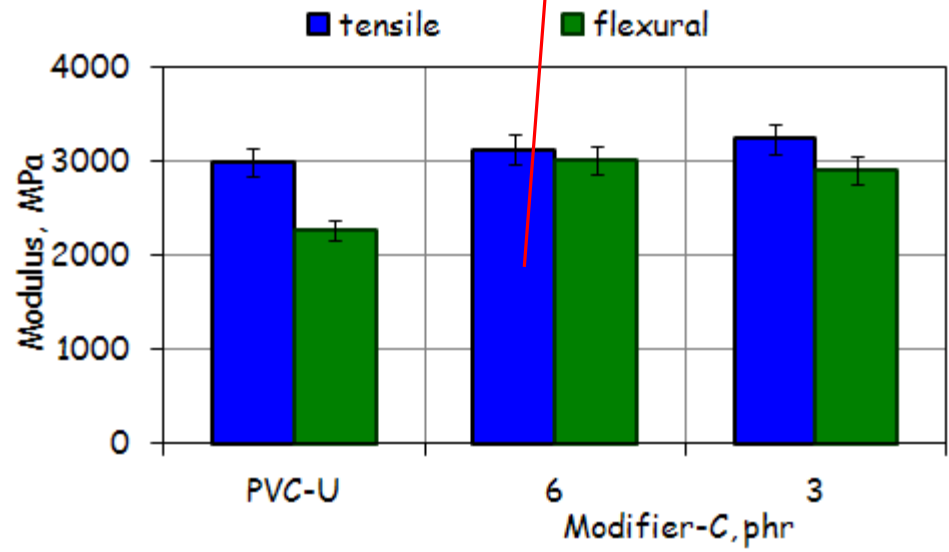
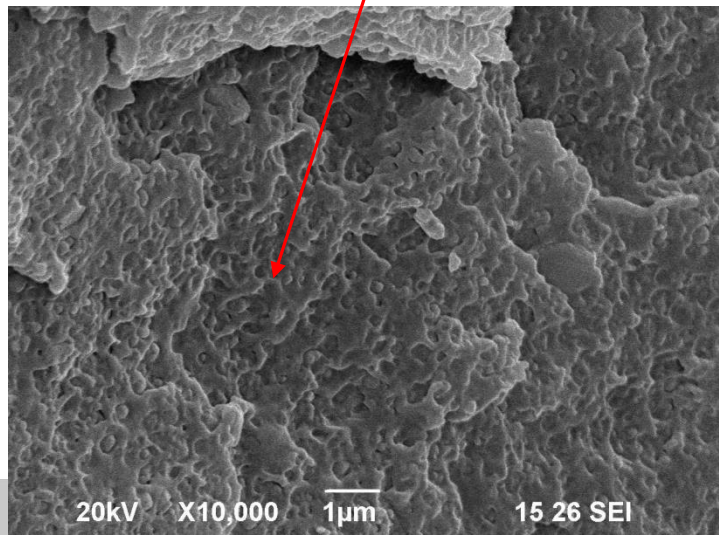
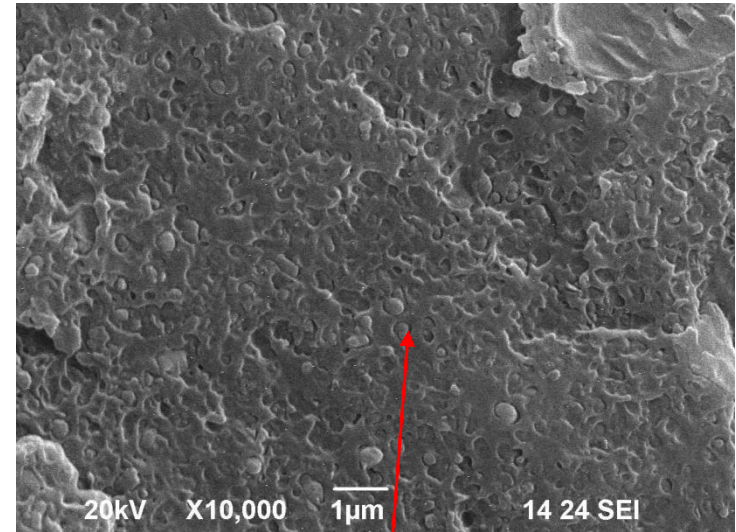
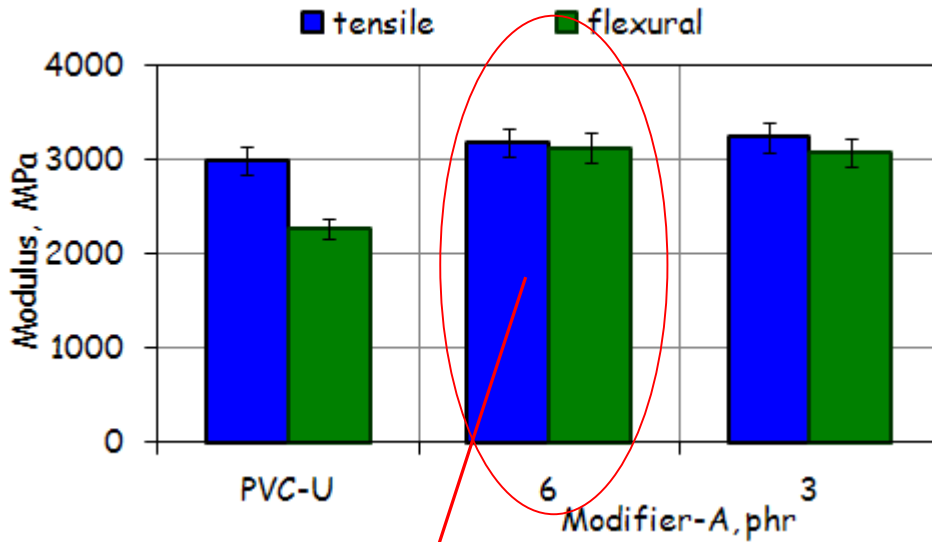
Mechanical properties of PVC-U/modifier composite



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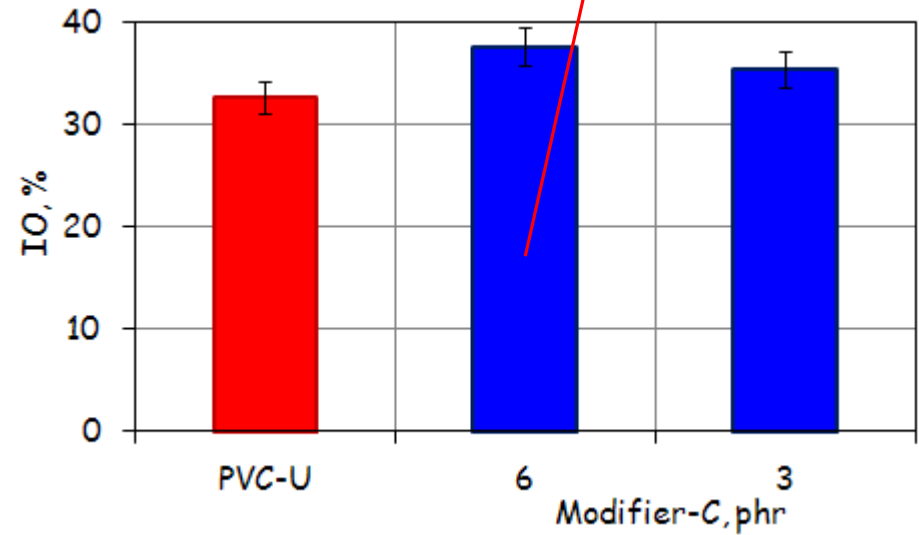
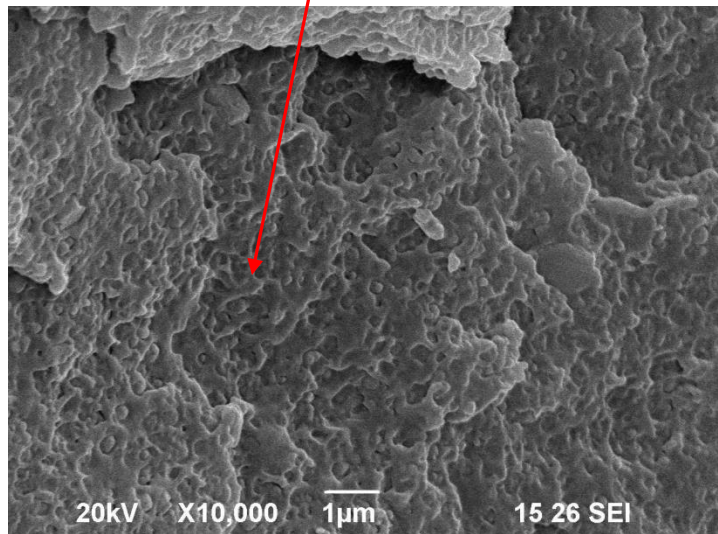
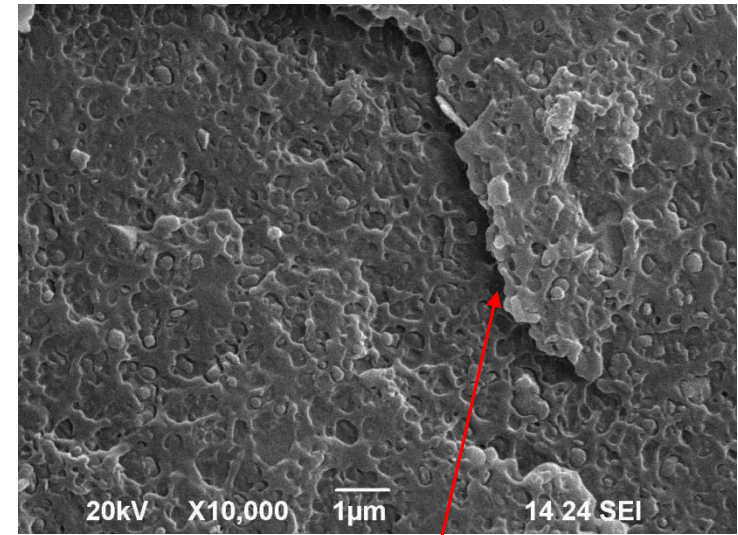
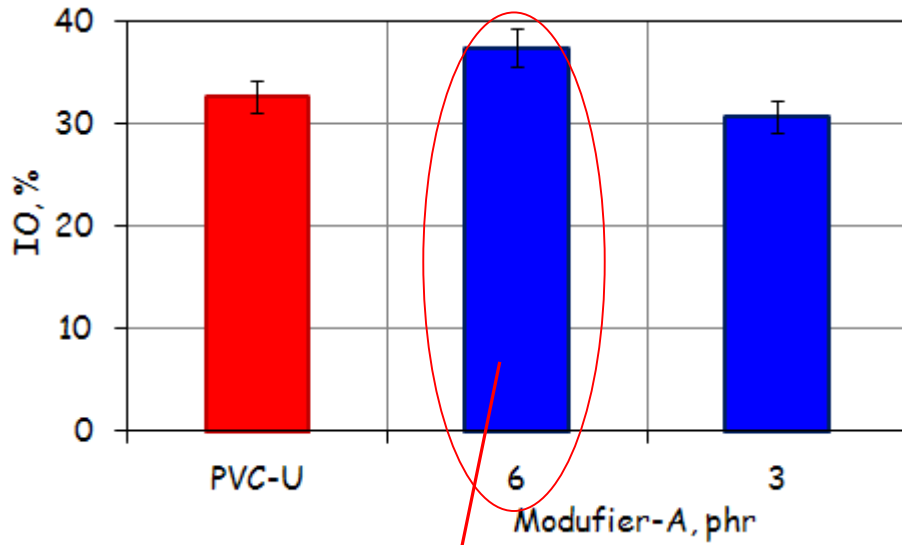




TGA: Thermal properties of PVC-U/modifier composite

Property	PVC-U	Plasticizer, phr			
		PVC-U /modifier (A phr)		PVC-U /modifier (C phr)	
	10	6	3	6	3
$T_{10}, ^\circ\text{C}$	281	279	280	275	272
$T_{50}, ^\circ\text{C}$	333	427	438	436	447
$T_{\text{max1}}, ^\circ\text{C}$	308	299	300	295	292
$T_{\text{max2}}, ^\circ\text{C}$	444	449	450	451	454

Oxygen index of PVC-U/modifier composite






Flammability of PVC-U/modifier composite

Properties	PVC-U	PVC-U/modifier (modifier-A phr)	
Plasticizer amount, phr	10	6	3
Time to ignition, s	63	94	125
Flameout (time of end of burning), s	395	572	392
Total heat evolved, MJ/m ²	43.8	45.0	40.2
Total oxygen consumed, g	28.6	29.9	26.6
Total smoke released, m ² /m ²	3692	3304	2851
Carbon monoxide yield, kg/kg	0.067	0.086	0.077
Carbon dioxide yield, kg/kg	0.78	0.90	0.78



- PVC-S70 - 100 phr
- **PLASTICIZER**
- **PLASTICIZER DEHT**  - 50 phr
- STABILIZER
- FLOW MODIFIER
- INTERNAL & EXTERNAL LUBRICANTS
- FILLERS (TITANIUM DIOXIDE, CALCIUM CARBONATE)
- **MODIFIER (with plasticizer)**



Parameters:

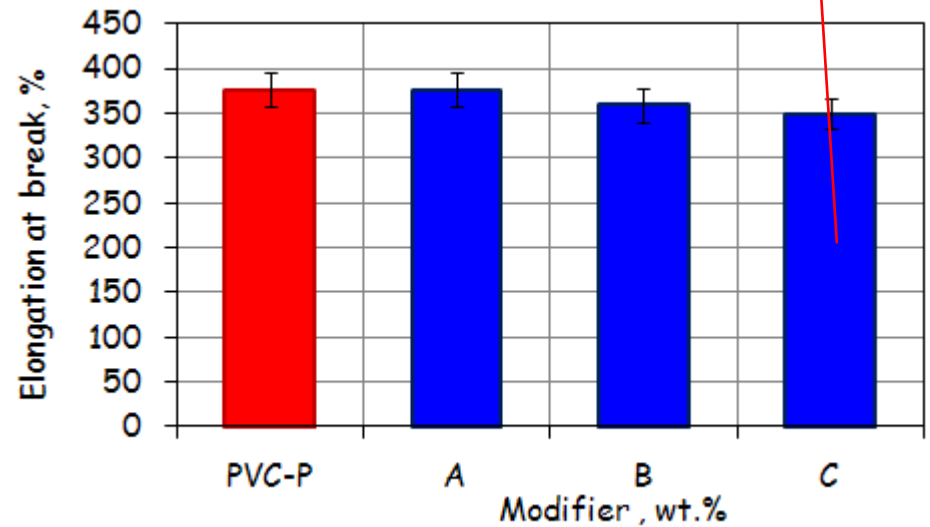
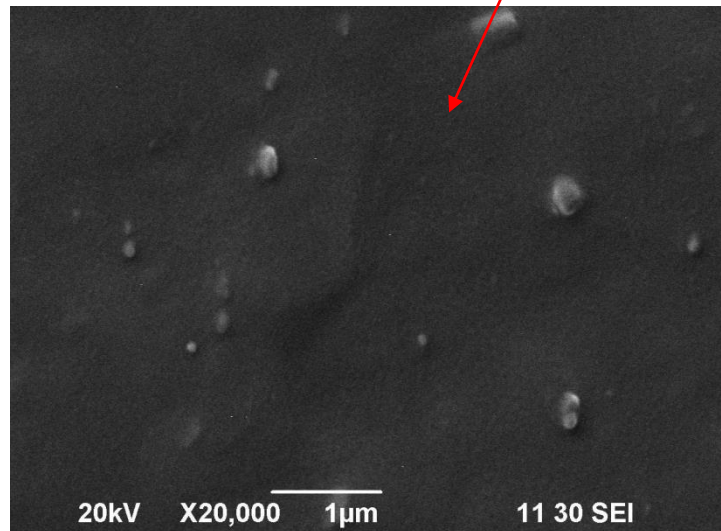
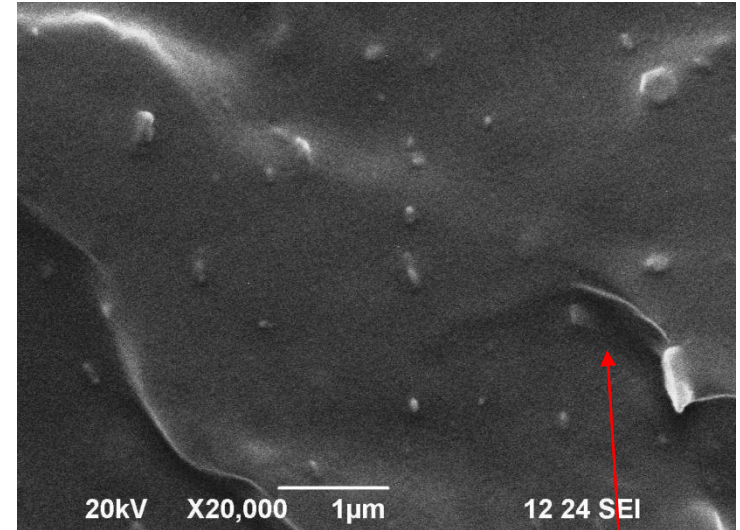
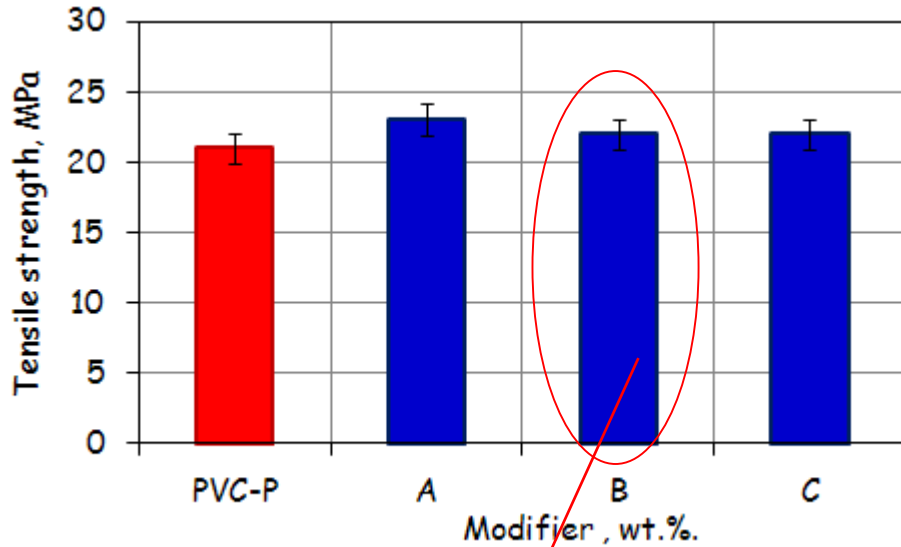
- ✓ Counterrotating twin screw extruder
Brabender (Plasti - Corder PL 2100)

$D = 42 \text{ mm}$
 $L/D = 6$

Process parameters for PVC-P composites	T (°C)	Rotational speed (min ⁻¹)	Yield (kg/h)
	165 - 175	35	4,5



Mechanical properties of PVC-P/modifier composite



TGA: Thermal properties of PVC-P/modifier composite



Property	PVC-P	PVC-P/modifier (modifier, phr)		
		A	B	C
$T_{10}, ^\circ\text{C}$	267	266	268	267
$T_{50}, ^\circ\text{C}$	310	309	311	307
$T_{\text{max1}}, ^\circ\text{C}$	301	297	297	295
$T_{\text{max2}}, ^\circ\text{C}$	436	436	453	439

Flammability of PVC-P/modifier composite



Properties	PVC-P	PVC-P/modifier (modifier-B phr)
Time to ignition, s	43	44
Flameout (time of end of burning), s	361	410
Total heat evolved, MJ/m ²	47.4	49.4
Total oxygen consumed, g	31.7	32.8
Total smoke released, m ² /m ²	4924	4625
Carbon monoxide yield, kg/kg	0.85	0.09
Carbon dioxide yield, kg/kg	0.84	0.80



1. Platelet-tubular filler modified with plasticizer may be successfully applied as a modifier for PVC blends
2. It can be used in an amount of several phr - without any other modification of blend composition, as well as for replacing some amount of plasticizer in the blend
3. The products obtained show **better flame resistance, better thermal stability** and similar or better mechanical properties



4. The use of modifier (A phr) in PVC-U blend let maintain the mechanical properties not deteriorated at 40 % lower load of plasticizers, and results in:

Better flame resistance:

50 % longer time to ignition,

45 % longer flameout,

10 % lower total smoke released

15 % higher oxygen index

Better thermal properties:

increase in T_{50} : **↑ 94 °C** and T_{max2} : **↑ 5 °C**

High impact strength: ↑ 40 %



5. The use of modifier (B phr) in PVC-P blend results in:

Better flame resistance:

13 % longer flameout,

8 % lower total smoke released

Better thermal properties:

increase in $T_{\max 2}$: **↑ 17 °C**

Mechanical properties - not deteriorated



Thank you for your attention

More information www.zak.grupaazoty.com

