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# New technologies for plastics recycling

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*IMP PAN*

# PET bottles recycling



Properly collected plastics  
PET, polyethylene, etc.  
can be used few times

Important is eco-design i.e.

- no plastics mixing
- proper labelling, etc.

Taurage collection system



# Fishing nets recycling in Taurage LT



Recycled plastics can be used for production of different products e.g. textiles, clothes, tents, etc.



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# Utilisation of wind-turbine blades



PROJEKT KONCEPCYJNY KŁADKI NA RZECZE SZPOTAWA  
AUTOR PROJEKTU: mgr inż. arch. Agata Kowalczyk upr. nr 55/02000/2016

WIDOK AKSONOMETRYCZNY



**WASTEMAN Integrated Sustainable Waste Management Systems decreasing pollution discharges in the South Baltic area.**

# Geotextiles

[Źródło: GEOmall.PL](http://GEOmall.PL)



Road geotextile for water separation produced from recycled polyester



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# What about the plastics in balast fraction?

## Plastics recykling

<https://www.geomall.pl/>

# Construction elements from waste plastics



**Substrate:** waste polietylen and polipropylen ~50:50

**Technologies:** extrusion

**Material recycling**



Źródło: Innotechnika Sp.z o.o., Gdynia

# UV resistant roof tiles from waste polyethylene

Źródło: tileco.pl

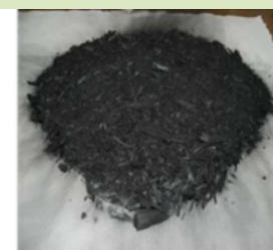


Źródło: Janpol <http://piroliza.com.pl/>

## Piroliza



Bio-oil



Bio-char



Syn-gas

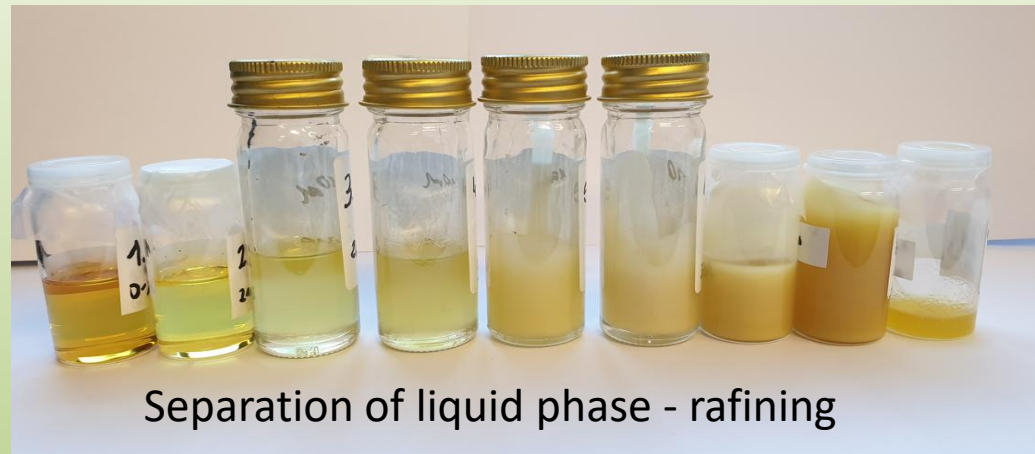
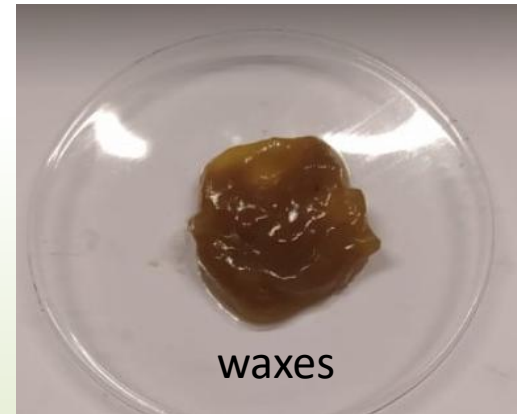


# Pyrolysis of plastics from wastes ballast fraction



IMP PAN pyrolysis chamber

Wax is a product per se (for cars)  
but it can find new application





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URZĄD MARSZAŁKOWSKI  
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# Road binding material against capillary rise from waste plastics



Projekt nr RPPM.01.01.01-22-040/18

OPRACOWANIE I WDROŻENIE EFEKTYWNYCH MIESZANEK STABILIZUJĄCYCH DO POSADOWIENIA NAWIERZCHNI

DRÓG Z WYKORZYSTANIEM UBOCZNYCH PRODUKTÓW SPALANIA Z ENERGETYKI W GDĄSKU

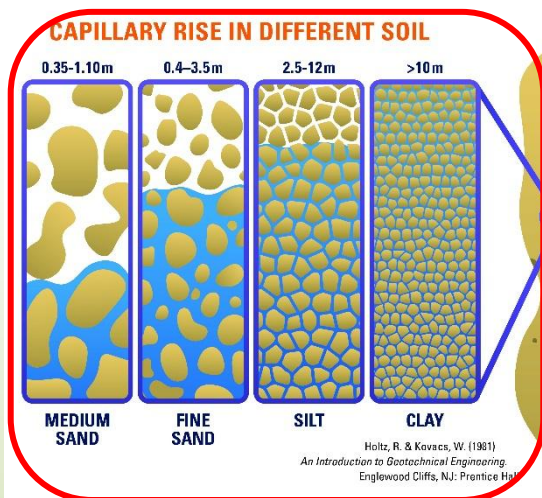
DZIAŁANIE: EKSPANSJA PRZEZ INNOWACJE, PODDZIAŁANIE: 1.1.1. EKSPANSJA PRZEZ INNOWACJE

Regionalny Program Operacyjny Województwa Pomorskiego na lata 2014-2020

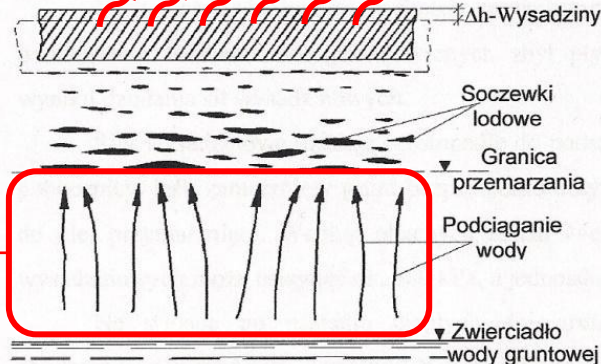
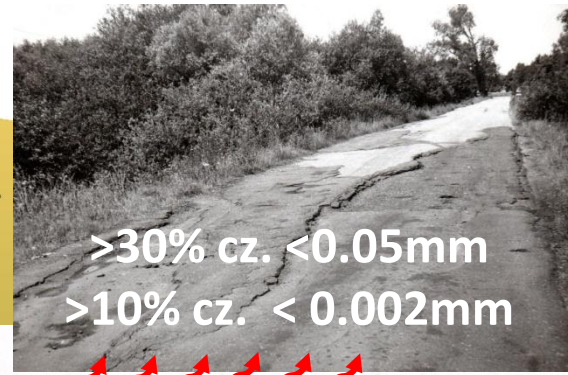


**WASTEMAN Integrated Sustainable Waste Management Systems decreasing pollution discharges in the South Baltic area.**

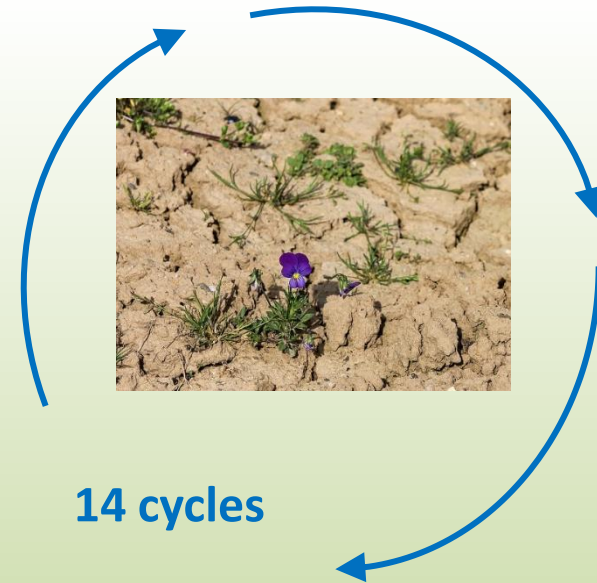
# Frost resistance and capillary rise



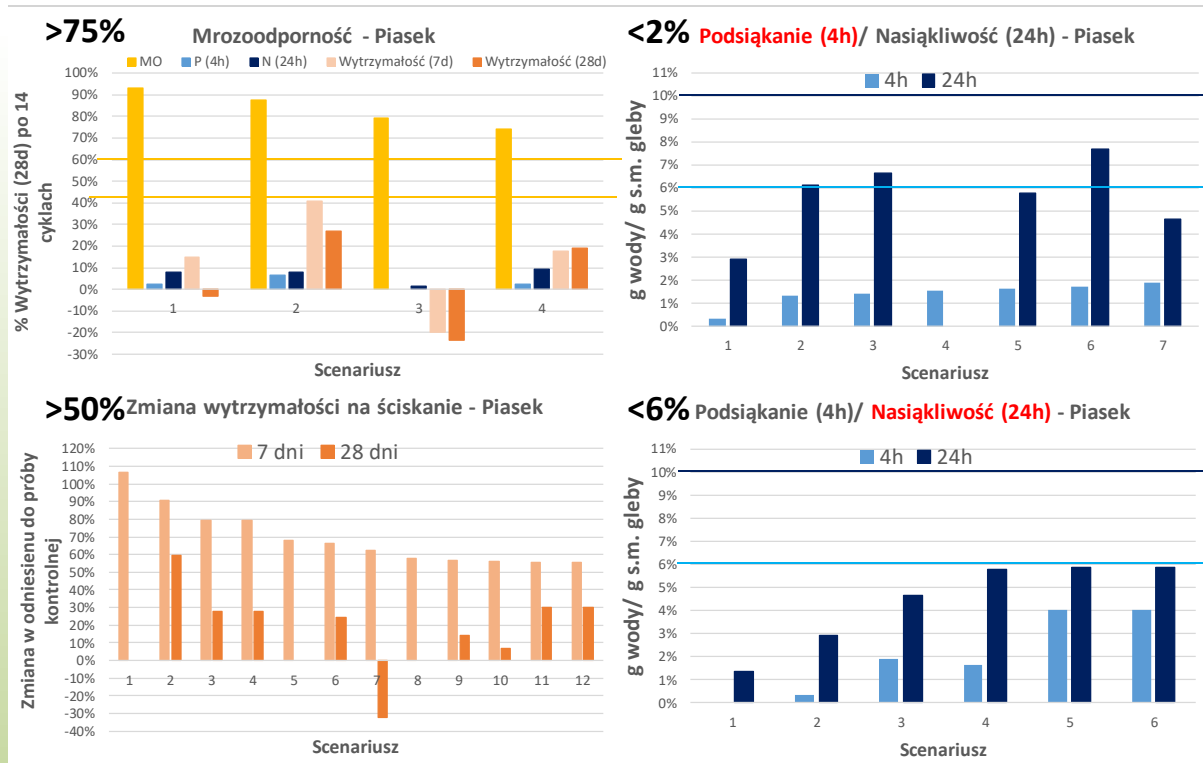
**Capillary rise in various soils**



Frost resistance



# Investigation of frost resistance, capillary rise, mechanical strengths (sandy soil)



# Tests procedures



Preparation



Implementation of 1  
binding material



Implementation of 2  
binding material



Cement addition

# Final test procedures



Mixing with the soil



finishung

# Pyrolysis of wind turbine blades



Źródło: Janpol  
<https://www.youtube.com/watch?v=8PvGYhJXxIs>



# Investigation of the pyrolysis oil

Olej 1 (chłodnica powietrzna)		
Nr	Faza górna (woda)	Zawartość [% m/m]
1	Propylene Glycol	0,80
2	1,4-Butanediol	0,37
3	Phenol	0,99
4	2-Propanol, 1,1'-oxybis-	1,03
5	1-Propanol, 2-(2-hydroxypropoxy)-	1,18
6	1,2-Ethanediamine, N,N'-diethyl-N,N'-	0,08
7	Phenol, 3-(1-methylethyl)-	0,10
8	p-Isopropenylphenol	0,17
9	2-Propanol, 1,1'-[(1-methyl-1,2-ethanediyl)bis (oxy)]bis-	0,70
10	N,N'-Diisopropylethylenediamine	0,05
11	1,2-Pentanediol	0,28
12	Propanol, [(butoxymethylethoxy) methylethoxy]-	0,12
Faza dolna (olej)		
	Faza dolna (olej)	Zawartość [% m/m]
1	Pyrazine, 2,6-dimethyl-	0,63
2	Phenol	15,45
3	Pyridine, 3,5-dimethyl-	0,58
4	Benzofuran	0,45
5	Phenol, 2-methyl-	2,92
6	p-Cresol	1,30
7	Benzofuran, 2-methyl-	0,35
8	Phenol, 2-ethyl-	1,19
9	Phenol, 3,4-dimethyl-	0,33
10	Phenol, 2-propyl-	0,49
11	Phenol, 3-(1-methylethyl)-	13,92
12	3-Methyl-4-isopropylphenol	1,11
13	p-Isopropenylphenol	2,83
14	Phenol, 2-(1,1-dimethylethyl)-3-methyl-	0,43
15		0,15

The various waste plastics were tested:

- car industry plastics, e.g. bumpers
- agriculture plastics, e.g. sacks, foils, ...
- plastic boxes
- tetra-pak
- artificial grass
- Battery cases

In some cases the liquid fraction could be send to refinery for “second life” products

Final stage is to produce syngas H<sub>2</sub>+CO and Fisher-Tropsch cycle



# Carbonizate application

- biochar
- filtration materials – activated coal
- Pigments, plastics fillers





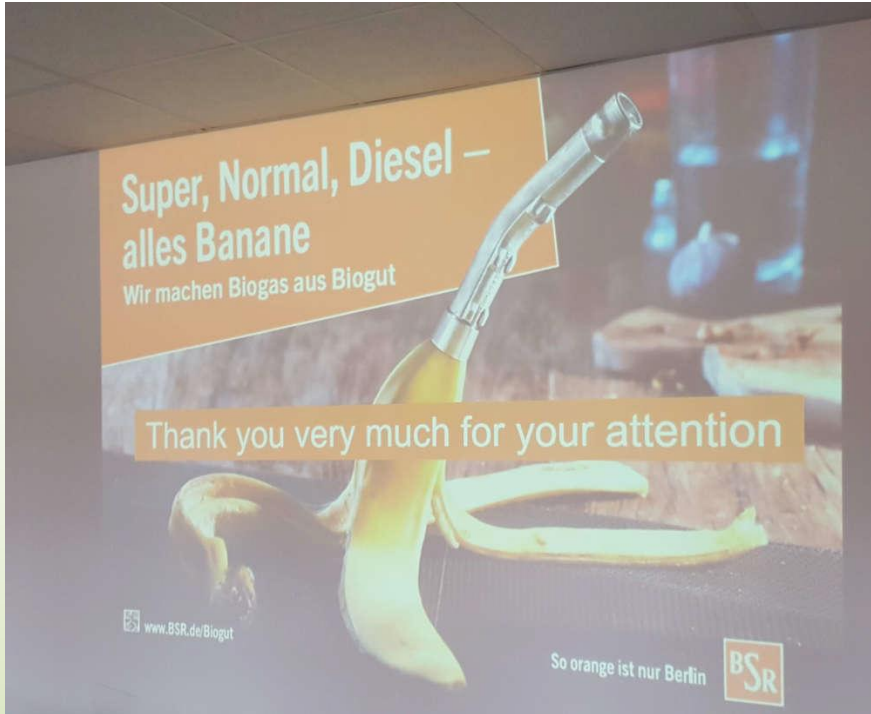
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# Conclusion

- Waste plastics fraction constitutes a serious problem for waste management, especially due to its mixed content as well as costs. The serious consideration should be devoted to careful design of packaging in order to enable its circularity (e.g. avoiding material mixing, proper labelling and information, etc.)
- In the case of uniform plastic waste its remoulding and secondary use (typical recycling) should be promoted (even if the process can be repeated only few times before plastic deteriorates). Another important group of technologies are related mechanical nonthermal processing and use for other purposes (e.g. as textiles and geotextiles).
- There are several low temperature technologies (still qualified as recycling) related to production of roof tiles, construction element, etc., that should be considered as secondary choice.
- As the plastics deteriorates the high temperature polymer-reforming usually related to pyrolysis can lead to generation of some monomers and smaller molecules (usually in liquid and gas phase) and carbonizate. The products can be used as materials for other processes (material recycling).
- Plastic waste-based pyrolytic products such as waxes effectively increase soil stability parameters (compression strength, sealing, frost resistance) and can be used for road construction. Some legal barrier limit the technology development and should be reconsidered.
- Final process of deteriorated plastics (packegeing) reforming is related to syngas generation which can be used for Fischer–Tropsch process (and start the second life for the new plastic or other materials).
- The actions directed to stimulation of market for recycled plastic are necessary in order to increase plastic recycling.



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Dziękuję za uwagę

