# Recovery of liquid carbohydrates from waste polyolefins using catalysed pyrolysis

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## ABSTRACT

In the paper a desk study is presented with six selected cases on state of the art technology and design trends for innovative sorting and collection methods for household waste including food waste, which are in agreement with EU directives.

## Introduction

Waste plastics constitute growing ecological problem due to long decomposition time and micro-plastics formation (especially in water environment e.g. oceans), which can often be found in food chain. Decomposition time is assumed to be 100 do 1000 years for PET bottles, shopping bags up to 400 years, diapers even 450 year.

There are several ways to solve the plastic waste challenge, including decrease of plastic production and use and plastic recycling. More and more disposable plastic products are changed to paper or wooden ones. Recycled plastics can be utilized to produce clothing, tent, roof tiles or construction materials.

Here we present the special recycling method based on plastic pyrolysis.

Fig. 1. Construction elements (plastic wells) and their application

Roof tiles from PE/sand composite

Fig. 2. Janpol pyrolysis installation

## Method

Janpol Technologie Sp. z o.o. (http://piroliza.com.pl/) company in cooperation with IMP PAN developed mobile catalyzed pyrolysis system (see Fig. 2) in order to maximize liquid carbohydrates yield. These can be used for fuelling combustion engines or be sent to refinery.

Fig. 3.

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**SPRAWOZDANIE Z BADAŃ nr S/91/20**

| | | | |
|---|---|---|---|
| **Zleceniodawca** | Instytut Maszyn Przepływowych im. Roberta Szewalskiego ul. Fiszera 14 80-231 Gdańsk | | |
| **Podstawa wykonania badania** nr zlecenia, nr umowy itp. | **Przedmiot badań** matryca | | **Stan próbek** Zgodnie z instrukcją I-01/PO-03 |
| Z/91/20 | Gazy, oleje | | Prawidłowy |
| **Miejsce pobrania próbek** zgodnie z informacją Klienta | **Data pobrania próbek** zgodnie z informacją Klienta | **Data dostarczenia próbek do laboratorium** | **Data zakończenia badania** |
| Nie dotyczy | Brak danych | 24.02.2020 | 06.05.2020 |

| | | | | | |
|---|---|---|---|---|---|
| 222. | SP329/20 | 2-Hexene, 3,5-dimethyl- | Chromatografia gazowa | 0,30 | %(m/m) |
| 223. | | Heptane, 4-methyl- | Chromatografia gazowa | 0,95 | %(m/m) |
| 224. | | Toluene | Chromatografia gazowa | 1,16 | %(m/m) |
| 225. | | Cyclopentane, 1,1,3,4-tetramethyl-, cis- | Chromatografia gazowa | 0,19 | %(m/m) |
| 226. | | Cyclohexane, 1,3,5-trimethyl- | Chromatografia gazowa | 0,62 | %(m/m) |
| 227. | | 2,4-Dimethyl-1-heptene | Chromatografia gazowa | 12,51 | %(m/m) |
| 228. | | Cyclohexane, 1,3,5-trimethyl-, (1.alpha.,3.alpha.,5.beta.)- | Chromatografia gazowa | 0,59 | %(m/m) |
| 229. | | Ethylbenzene | Chromatografia gazowa | 1,23 | %(m/m) |
| 230. | | Cyclohexene, 3,3,5-trimethyl- | Chromatografia gazowa | 0,29 | %(m/m) |
| 231. | | 1-Nonene | Chromatografia gazowa | 0,16 | %(m/m) |
| 232. | | 2-Pentanone, 3-[(acetyloxy)methyl]-3,4-dimethyl-, (.+-.)- | Chromatografia gazowa | 1,07 | %(m/m) |
| 233. | | Styrene | Chromatografia gazowa | 6,37 | %(m/m) |
| 234. | | Benzene, (1-methylethyl)- | Chromatografia gazowa | 0,41 | %(m/m) |
| 235. | | .alpha.-Methylstyrene | Chromatografia gazowa | 3,04 | %(m/m) |
| 236. | | Hexane, 2,4-dimethyl- | Chromatografia gazowa | 0,86 | %(m/m) |
| 237. | | Heptane, 2,5,5-trimethyl- | Chromatografia gazowa | 0,77 | %(m/m) |

## Results

Among the first studied substrates were wastes from polyethylene (PE), polypropylene (PP), polyethylene terephthalate (PET), polyvinyl chloride (PVC) as well as tires. The cable covers, plastic from automobiles and lighting systems, car batteries, rubber gloves, plastic bags, Tetra Paks, protection clothing and artificial grass were used. The process temperature varied between 360 – 440 C.

As a result up to 85 % of liquid carbohydrates and 15% of gaseous one and char. The list of liquid carbohydrates is shown in Fig. 3. Calorific value of pyrolytic gas reached even 35,5 MJ/kg and of char 31,2 MJ/kg.

## CONCLUSIONS

The developed installation enables production of high quality liquid hydrocarbons from waste plastics. The obtained liquid fraction is a high value product and can be used as substrate in refinery.

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