APPLICATION HIGHLIGHT:

OptiDist: Analysis of Waste Plastic Pyrolysis Oil (WPPO)

Introduction:

Because of the rapidly growing world population, improved life span and increased standards of living, the petrochemical industry is growing fast. However, this brings an accumulated amount of plastic waste as well. Globally, since the invention of the first plastic early 1900s, the amount of the total accumulated global plastic waste has reached to 10 billion tones. More than half of it is still in the form of waste because the recycling rates are well below 10% today. Indeed, most of the recycling includes either dumping in the field or energy recovery (incinerations).

However, triggered by globally growing sustainability concerns, the companies and nations started to take extra precautions to minimize the plastic waste together with improved recycling initiatives. One of the important technologies gaining ground is chemical recycling, which includes the thermal pyrolysis of waste plastics.

The pyrolysis process provides an emerging, valuable but also a challenging feedstock, namely Waste Plastic Pyrolysis Oil (WPPO). Although WPPO can be used for fuel manufacturing or new petrochemical production purposes, its intrinsic chemical & physical properties bring its own challenges. Among the current needs of WPPO analysis, understanding the distillation properties is an important one which would enable the end customers to optimize their pyrolysis process, be in compliance with relevant guidelines & specifications as well as perform fast screening studies of vast amounts of WPPO samples in a short period of time.

PAC has a complementary distillation portfolio starting with process offerings of MicroDist, covering GC solutions of SIMDIS and extending to innovative-true lab measurements performed by OptiDist & OptiPMD. This app note provides details on method description and lessons learnt from WPPO analysis by OptiDist according to ASTM D86.

Method Description & Results:

Distillation analysis of WPPO samples is performed by OptiDist according to ASTM D86. Experimental runs on WPPO is done based on volumes. 4 different WPPO samples were analyzed. Each run requires 100 mLs of sample. Measurements are performed in the range of 0 – 450°C. Analysis methods are slightly adjusted for different WPPO samples by still staying with in the method limits. The accuracy of the analysis is assured by Pt 100 IEC 751 probe class A.

The samples are found to have varying chemical content thus different distillation profiles are seen. The samples having a higher paraffinic content which gave clogging issues. This is possibly explained by light fractions which are evaporated during the course of the distillation analysis resulting in disturbance of the equilibrum keeping the heavier parafinics in dissolved mode thereby triggering condensation reactions and finally clogging the condenser tube. This suggests that analysis of WPPO samples by OptiDist can be performed up to 450°C successfully but anything above 450°C or any sample with higher parafinic content should be hanlded with further diligence.

These challenges can be overcomed by slighlty adjusting the parameters such as condenser temperature by staying with in the method limits depending on the nature of the samples. The distillation results of a sample are given in below Figure 1 & Table 1-2.

Figure 1: IBP, FBP and corresponding distillation temperature sara of the WPPO sample-1

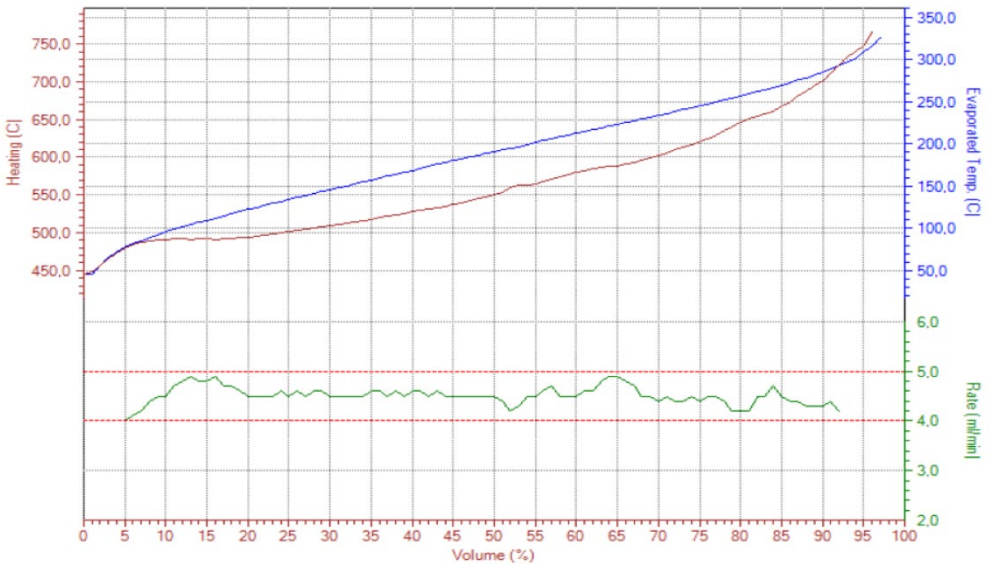

Table 1: IBP, FBP and corresponding distillation temperature sara of the WPPO sample-1

Volume	Observed	Corrected
IBP	46.1°C	46.2°C
5%	84.8°C	84.9°C
10%	100.9°C	101.0°C
15%	114.1°C	114.2°C
20%	126.6°C	126.7°C
30%	149.6°C	149.7°C
40%	172.6°C	172.7°C
50%	194.9°C	195.1°C
60%	216.2°C	216.3°C
70%	237.6°C	237.8°C
80%	260.9°C	261.1°C
85%	274.7°C	274.9°C
90%	291.7°C	291.9°C
95%	322.7°C	322.9°C
FBP 95.9%	332.1°C	332.3°C

Table 2: Recovery, residue and loss data of WPPO sample-1

Distillation Results			
Percent recovery:	96.9%		
Percent residue:	1.3%		
Percent total recovery:	98.2%		
Percent loss:	1.8%		
Corrected percent recovery:	970%	Corrected loss:	1.7%
Corrected percent recovery:	97.0%	Corrected total recovery:	98.3%

Conclusion:

The OptiDist is an excellent distillation instrument which can be used for the analysis of WPPO according to ASTM D86 or EN/ISO 3405. For the user, OptiDist provides much higher sample throughput and a faster response with superior precision to their specific analysis requests. It can be used for product certification in the lab, for optimization support to process engineers or to perform comparative experiments on shared samples at various locations with a globally acknowledged method.

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