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Your ref. :
Our ref. : BE-23-01-2019
Date : February 21th 2019

Concern : Eurex installation

Dear All

From November 2018 until end of January 2019 I have visited the installation in Sered 3 times. Goal was to do a technical due diligence for a Dutch customer that wanted us to install such an installation on his site. The business case looked interesting enough but there was a need at the customer to have local support and installation works by our company, and for this we did the 3 visits. The project is on hold at the moment because of some personal issues at our Dutch customer.

The installation in Sered takes in plastic (PP & PE) and makes a middle distillate from this like a diesel fuel. As by products there is a ash waste, a light fraction (petrol like), a water fraction and a gaseous fraction. Temperatures in the process and the cleanness of the input decide how much from each fraction you get. During my visits approx. 80% of the plastic was converted to middle fraction distillate (diesel) and 12% to the light fraction and water and about 5% of gas and 5% of ashes. These numbers are better then communicated by Eurex, due to the cleanness of the plastic delivered by our Dutch customer.

Plastic from our Dutch customer was shipped to Sered to be turned into diesel. Goal is to put a special diesel generator at the site and to run the engine on the 'diesel' produced.

Here is a photo from the shredded product as it was ready to put in the machine. The shredding was done in Sered, by the people on site. The supplied product was industrial PP & PE waste (mainly PE-foil) that is collected by our Dutch customer. There is enough of this nice waste at our customer to run at least 1 installation.

There was a lot less non plastic in this run as there would be om MSW plastic. This is why the results are better on this plastic then on a typical MSW input. There is less ash.

In this next picture you see an example of bales also on site that are from MSW. The plastic look a lot dirtier and will give more ash.

On this product you might find up to 20% ash, and then the middle distillates will be at approx. 60% of the input weight.

Depending on the PE / PP composition best results will be achieved at different temperatures. We were not able to witness this, but technically we understand that this will be the case.

Tests samples of middle distillate and light fraction and gasses were taken by me.

The analysis showed the middle fraction to be well in the diesel range. The most modern engines with common rail might not run well on this fuel because the composition of the different components in the diesel differ quite a lot and these engines are very sensitive to this, but older model engines that are still delivered new are very suited for this fuel. On site there are Cummins KTA type of engines and we would select the same engines for this fuel. The PT pump system already has reasonably good efficiency and it will handle this fuel. We have the same type of engines running of palm oil and animal fat.

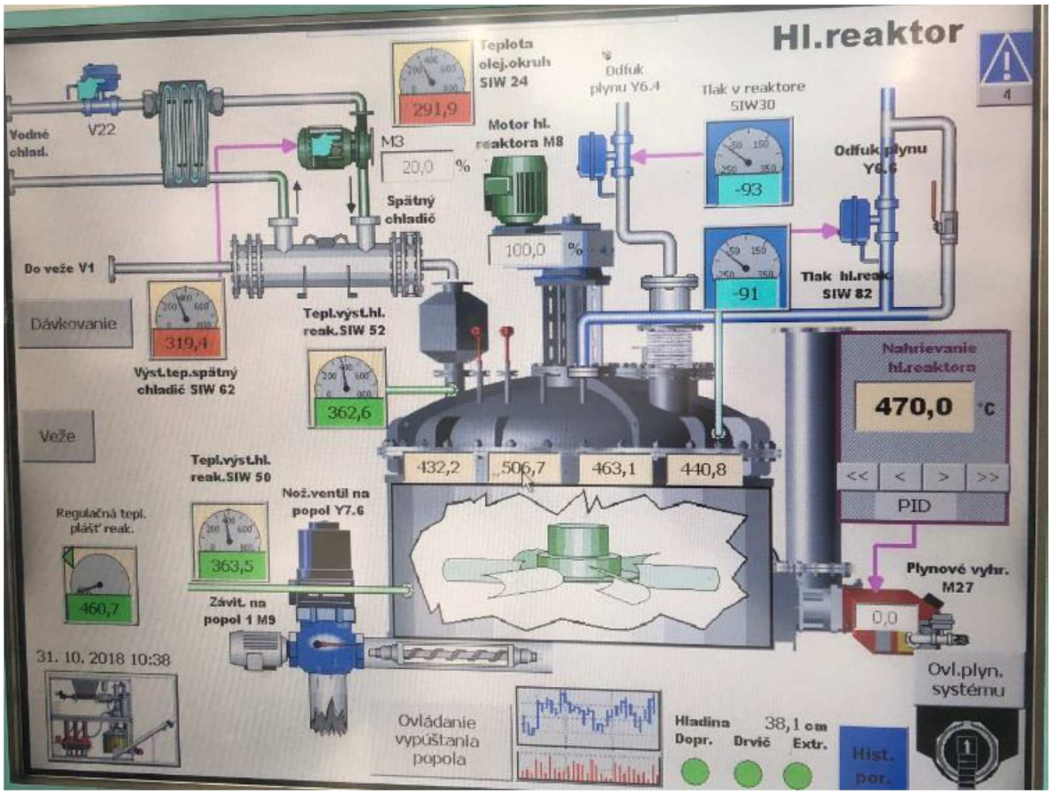
Technical principle of the plant.

The plant is very cleverly set up by someone with a chemical background. Also some of the surrounding equipment is well chosen. The plant has the following 4 basic steps:

1. Hopper to receive the shredded plastics. As agitator in the hopper there also is a cutting knife to get a good feed in into the extruder
2. Extruder, inhere the plastic is changed into a gel, also the heat goes up to close to 200°C, and here and in the hopper all water is evaporated and escapes as steam from the process.
3. The extruder then drops it into the main reaction vessel. This vessel is kept at a temperature around 450°C, to break the long PP & PE chains into middle fraction chains. Through a reflux system the gases are condensed / recirculated in the main reaction vessel until they are small enough for the middle fraction. The middle fraction gasses then escape from the main reaction vessel. This vessel in heated indirectly by 3 burners that run first on natural gas (or any other fuel) and as the process is started and gasses are produced the burners are switched to these gasses.
4. The gasses that have escaped are then cooled in 3 condensors down to a temperature for the right fraction. From the first condenser the heavy middle fraction are retrieved as condensate. From the second one the light, but still middle fraction is retrieved as condensate and both these streams together are the middle fraction. The last condenser then cools down to 30°C or 40°C, and here water and light fraction are condensed. This condens can then settle in a settle tank and then due to the big difference in density the water can be drained of at the bottom and light fraction will stay in the tank and be pumped to a storage tank for the light fraction. The gases that are left over flow into a buffer tank, and then through a compressor it is used in the burners of the primary reaction vessel.

Temperature control

Temperature control I very important. If the reaction vessel is too hot and / or the reflux temperature is to low, more gas will be produced. If the reflux temperature is too high, more long components will get through and the diesel might then get to much heavy components compared to normal diesel. This will increase the heating value and engines like the Cummins can run on this. On common rail engines the viscosity might get to high. If the condensation vessels are to cold to many light components might get into the diesel and the engines might start knocking on this.



The number of people walking around on site was a bit disturbing. But I think that with improving the controls and the protocols and the feed in system and with some changes that are already planned, it must be possible to run the plant with 1 person supervising it. Now the plant has to stop for the ash to be taken out, but they are working on a method to do it on-line.

Conclusion:

From my perspective I think the underlying technology is very well chosen. I have seen a number of pyrolysis plants over the last 5 years, and the resulting pyrolysis oil, and none has been as clean and well defined as this oil. The unit is run for the last couple of years as pilot / test installation so the current state should not be indicative of the supply of a new installation. The operators on site will also train the operators of the new plants and they are up to the job. The input and output of the installation in Sered needs a lot of manual labour, and this should be improved for a commercial plant. I would not hesitate to advice a customer of our company to invest in this installation.