

## ***Low Temperature Hydration***

Catalytic Depolymerisation Process- Conversion of Waste to Diesel or

Catalytic hydration with biomass as the hydrogen carrier by low temperature and low pressure

### Preamble

As we know, hydration and gasification are competitors since long time in the fuel production. Many combination are developed for the hydration with hydrogen and the gasification with air, oxygen and steam. In spite of the higher efficiency of the hydration the gasification was more used than the hydration. The reason for was the high pressure of more than 90 bar for the hydration with hydrogen gas with Nickel catalyst.

After the gasification showed many problems with sticky particles, dioxins and furans the competition with the hydrogenation is new discussed.

### Discoveries in hydration

Not expected was discovered a new way in the hydration. When hydrogen in the reaction is substituted with biomass, then the necessary pressure for the reaction can be reduced from 90 bars to less than normal pressure. For this process we don't need nickel as the catalyst, we can use the much cheaper minerals of the biomass in form of Cation-aluminium-silicate. Also the reaction temperature drops down to less than 300°C.

We have to respect for this reaction the other energy input in the reaction. This reaction is not possible by heating from outside. This reaction takes place only by friction, also by heating in a mixing chamber, also called as a friction turbine. Nobody heat a reaction by friction before. Nobody tries to heat a chemical reaction with a friction turbine. Therefore nobody before Alphakat could find this soft hydration system.

Under the special condition of

- energy input in form a mixing chamber, called friction turbine
- catalyst in the circulation medium for the system in form of cation-aluminium-silicate in the range of 5 to 20 %

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we have a destruction of the biomass to the fuel molecule on the example of cellulose (1) and sugar (2) in form of

1.  $C_6H_{11}O_5 = 2,5 CO_2 + (CH_2)_n (3,5) + H (4)$
2.  $C_6H_{12}O_6 = 3 CO_2 + (CH_2)_n (3) + H (6)$

This 4 or 6 hydrogen (in stadium nascenti) hydrates the input material by normal pressure or underpressure all hydrocarbon including olefins, like plastic, oil, rubber and bitumen, to alkanes and substitute the catalyst in the reaction mass with hydrogen to realize such a low temperature of less than 300°C. This is a pure chemical reaction and has nothing to do with thermal splitting, pyrolysis or thermal destruction. Therefore the product is chemical with high quality, has no smell of pyrolysis and contains no ammonium, dioxins, furans and light components. Nobody went this way of the nature. All the crude oil is produced like this by lower temperature (14-19°C) and much longer reaction time.

To get to know this reaction was not easy, because all the prejudgments of the chemical engineering shows in the other direction. Only the consequences to continue of looking for a 100 % dioxin free process lead the scientific activity to this process. Finally we found this reaction in a special mixing system with molecule fine powder of the cation-aluminium-silicate with addition lime in the reaction to hold the pH-value higher than 8,5. Then we found an unlimited life time of the catalyst.

#### Hydration Test using Biomass

We discovered the process and the chemical structure in a special test series. A customer wants to test residues from sun flower residue in the conversion to fuel. We test some times 5 kg input and got 15 l diesel for each test. Therefore it was demonstrated, that the hydrogen of 5 kg press residue from sun flowers can hydrate 15 l waste oil to saturated hydrocarbons in the boiling range of 260°C. This is diesel. In other words, the hydrogen production of 1 kg biomass hydrates 3-4 kg mineral residues to diesel. In the case of coal we need another relation of biomass to coal with more biomass.

What is the efficiency of the biomass in mixing with other hydrocarbons:

- hydration of the oil and plastic to alkanes and
- substitution of the catalyst for the CO<sub>2</sub>-extraction and depolymerisation with hydrogen to make the product evaporable, this means the chemical product diesel is not longer covered from catalyst and can evaporate in the product line.

#### Use of Catalyst

The catalyst which allows this reaction can be added to the process in the following way:

- we add cation-aluminium-silicate produced in the silication of sodium-aluminate or
- we use biomass plus lime for the production of diesel fuel and the ash is our catalyst that we need also for the industrial and municipal waste applications.

This molecule fine catalyst allows a new catalytic system

- not stored in a vessel in form of pellets or honeycomb,

- the catalyst is fine suspended in the circulation oil and goes to the input of hydrocarbon to make the CO<sub>2</sub>-extraction and the depolymerisation.

This is the new system of the opposite catalytic reaction with the catalyst coming to the input and not the reaction mass is going to the catalyst. This is supported by the high friction in the friction turbine. This system of chemical conversion makes the high product quality of saturated hydrocarbons. This is new and now other production system in the chemical industry use the friction turbine for heating and reaction and use the bottles only for the separation.

### Technique improvements

In other words, up to now, in no other place of the technique of chemical plants we use the friction to heat and make the process. This is new in the technique and leads the fuel production in the direction of cheap catalytic hydration with biomass and the minerals of the biomass as the catalyst.

When we now relate the invest of the old processes with the new low pressure process with

- 90 bar hydrogen Nickel catalyst, higher temperature with heating from outside or
- underpressure, biomass as carrier for the hydrogen and heating with the friction turbine in form of

we can realize, that the low pressure hydration with biomass is much cheaper than all the old processes of gasification, pyrolysis and high pressure hydration with hydrogen gas.

### The KDV process

This can be decisive in the production of fuel, because the KDV-system is complete environmental friendly and the cheaper way to get the hydration. The efficiency is regarding to the low reaction temperature very high in the range of 70 - 91 %. All the dangerous materials, like chlorine, fluor and molecule fine metals are absorbed by the lime with the high pH-value and the crystalline catalyst.

The hydrogen content of the biomass is about 20 %. This is going the way of the hydration and in the case of pure biomass the way to the production of water. This hydrogen is consumed in the mixing with technical production more for coal, transformer oil, PVC, Teflon, rubber, bitumen and refinery residue and less for plastic, waste oil and polymers like PE and PP.

All material, you can burn, you also can convert to diesel in the KDV

In summary we get the following result with the low hydration process KDV:

- as long as we have in the mixture enough biomass we get a unique product diesel with saturated hydrocarbons
- we don't need pressure
- the catalyst is coming from the biomass or synthetic from Alphakat and Partners
- we don't get any emission from the plant
- we realize the vacuum system for inherent safety an
- we can't form any poison hydrocarbons like Dioxins and Furans.

The KDV is therefore environmental friendly and has the highest efficiency from all know processes.