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Item 66

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Subject: Hydrocarbonsynthesis with Iron Catalysts.

Paraffins:

We have worked with activated Iron catalysts of various compositions. Our immediate aim has been the synthesis of a straight-chain paraffin, as a starting material for the oxidation of paraffins. By using a synthesis gas consisting of 1CO + $2H_2$ and operating at 205-225°C, we are in a position today to produce a product of which 70% boils above 320°C, 15% boils below 200°C and another 15% boils between 200-320°C of the fraction of the primary product, boiling above 320°C, 90% consists of straight-chain Paraffins. Of the mentioned fraction, one-third boils between 320°-450°C, the rest boils above 450°C. This high boiling portion may be cracked to give 65-70% of a paraffin of boiling range 320-450°C. Therefore, about 50% of the total primary product are available for the oxidation.

For operation on a larger scale, it will be necessary to employ recirculation or step-wise operation, and the CO_2 has to be scrubbed out as well as the products have to be condensed. The calculated yield, referred to synthesis gas employed, amounts to 180 g/m^3 of gas used. Hence, if 80% of this can be realized, one should obtain 145 gas of liquid + solid products per standard m^3 of gas.

Olefins:

When a synthesis gas of composition 1CO + 1 H_2 is employed, using the same precipitated catalysts the formation of olefines is favored greatly. Employing one gas passage at 210°-230°C and a CO conversion of about 30%, a product is obtained which contains around 50% of olefines boiling above 200°C. 80% of the product consists of straight-chain molecules. The combination of CO with H_2 takes place in the ratio of 1:1, i.e., in the same ratio which the starting gas has. This method opens the possibility to make the middle fractions available for the OXO reaction, whereas the higher boiling fractions after hydrogenation may be used for paraffin oxidation.

The use of Sintered Iron Catalysts for production of olefines calls for higher working temperatures, and also for lower (half) space velocity and higher contact time. The olefin content in the middle and higher boiling fractions amounts to 75 respectively 60%. The catalyst has shows the tendency to convert an original synthesis gas of composition $1CO + 2H_2$ im the ratio 1CO to $1H_2$. If the catalyst is allowed to work upon a gas of composition $1CO + 1H_2$ from the beginning, it converts it in the ratio of $1CO : 0.6H_2$. This observation has been frequently made with precipitated catalysts of different compositions. The olefines of boiling range 200-320°C contain approximately 65% of straight-chain hydrocarbons, the higher boiling fractions contain around 75% of straight-chain molecules.

The required higher temperature, as well as the use of CO and H_2 in a ratio differing from that of the original gas, speaks against the use of sintered iron catalysts and clearly demands the use of precipitated catalysts for the olefine synthesis.

Alcohols:

The production of alcohols from CO and H_2 has been attempted at moderate and higher pressure, using fused iron catalysts, sintered iron, and precipitated iron catalysts. Up to now no definite information can be given on this work.

However, the qualitative results may be readily recognized when the above mentioned catalysts are employed, there is reason to believe that using precipitated catalysts at higher pressures (above 50 atm.) a very good yield of alcohol is obtained, and without noticeable carbonyl formation. The alcohols are valuable as starting materials for production of fatty acids. For example, alcohols of the following boiling range are obtained:

Boiling Point	%	% Alcohols
- 200°C	60	35
200 - 320°C	20	40
320 - 450°C	13	45
above 450°C	7	55

Total yield: 70 gms with a single gas passage, resp.
180 g/standard m^3 of gas converted.
Conditions: 200 atm. space velocity: 500:1

With sintered catalysts and approximately the same working conditions, preferably lower alcohols C_1 - C_5 are obtained.

The use of fused iron catalysts was postponed for some time, on account of the poor yields which those catalysts give when employed under our working conditions.

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