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Production Efficiency and Safety Assessment of the Solid Waste-derived Liquid Hydrocarbons

WtL problematics through Fischer-Tropsch catalytic synthesis

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SRF Gasification Process

Gasification unit





Producer gas characteristics

SD^b Component Symbol Unit SRF $[m^3 \cdot h^{-1}]$ Producer gas flow 85 Qg $[M] \cdot m^{-3}$] LHV Lower heating value 3.6 0.09 HGE Hot gas efficiency [%] 79 Carbon monoxide CO 0.30 [% vol.] 10 [% vol.] Hydrogen H_2 0.12 9 Methane CH_4 0.10 [% vol.] 4 Carbon dioxide CO_2 [% vol.] 9 0.18 0.02 Oxygen O_2 [% vol.] 1 Other^a Х 67 [% vol.] 1.28

Producer gas parameters and chemical composition.

Notes: Values for dry, PM/tar free (293.15 K, 101325 Pa) gas. ^aValue represented mainly by atmospheric N₂. ^bStandard deviation.



Fischer-Tropsch catalytic synthesis study

- Different Co-based catalysts applied
- Influence of temperature was observed
- Process efficiency was determined
- Product qualitative and quantitative analyses were performer
- Off-gas composition was monitored



F-T reactions

$nCO + (2n+1)H_2 \rightarrow C_nH_{2n+2} + nH_2O$
$nCO + 2nH_2 \rightarrow C_nH_{2n} + nH_2O$
$CO + H_2O \rightarrow CO_2 + H_2$
$nCO + 2nH_2 \rightarrow C_nH_{2n+1}OH + (n-1)H_2O$
$(n+1)CO+(2n+1)H_2\rightarrow C_nH_{2n+1}COH+nH_2O$
$2CO \rightarrow C + CO_2$



F-T technology description

Fischer-Tropsch unit





F-T technology description

Fischer-Tropsch unit





F-T process input parameters

Parameter	Unit	Value
Temperature	[°C]	250/280/310
Pressure	[bar _g]	15
GHSV	$[h^{-1}]$	1145
GHSV/C	$[\underline{l}\cdot\underline{g}^{-1}\cdot\underline{h}^{-1}]$	1.4
Catalyst mass	[g]	8
Inert SiO ₂ mass	[g]	2
Experiment duration	[h]	30
H ₂ activation temperature	[°C]	400
H ₂ activation pressure	[bar _g]	0
H ₂ activation duration	[h]	2



Catalysts

Al₂O₃-supported





Quantitative analysis

Parameter	Unit	Value					
Catalyst		Cat-Co Cat-CoMnK					ıK
Temperature	[°C]	250	280	310	250	280	310
Liquefaction number	[% w/w]	12.0	19.5	9.9	<1	17.8	10.3
Total of HC	[% w/w]	3.4	6.6	2.0	0	8.3	5.5



Qualitative analysis









Highlights

- Solid waste gasification producer gas performs well in F-T tehnology
- CoMnK catalyst selectivity towards longer C groups
- The off-gas is re-introduceable/utilisable



Thank you for your attention

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