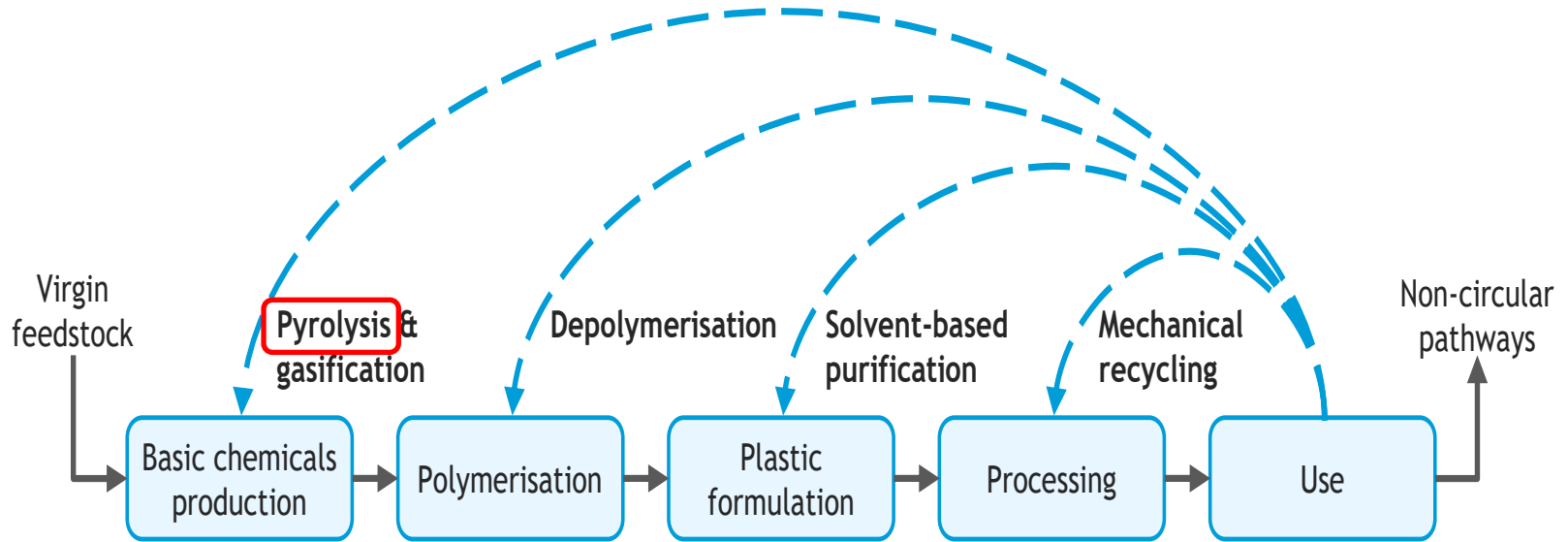




**CHEMICAL RECYCLING VIA PLASTICS  
PYROLYSIS —  
TECHNICAL AND LEGAL HURDLES ON  
THE ROAD AHEAD**

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November 23<sup>rd</sup>, 2021*

# RECYCLING OPTIONS



# PYROLYSIS

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- Wikipedia:
  - *The **pyrolysis** (or devolatilization) process is the thermal decomposition of materials at elevated temperatures in an inert atmosphere. It involves a change of chemical composition. The word is coined from the Greek-derived elements pyro "fire" and lysis "separating".*
  - *The process is used heavily in the chemical industry, for example, to produce ethylene, many forms of carbon, and other chemicals from petroleum, coal, and even wood, to produce coke from coal. It is used also in the conversion of natural gas (primarily methane) into non-polluting hydrogen gas and non-polluting solid carbon char, initiating production in industrial volume. Aspirational applications of pyrolysis would convert biomass into syngas and biochar, **waste plastics back into usable oil**, or waste into safely disposable substances.*

<https://en.wikipedia.org/wiki/Pyrolysis>



# PLATTS CIF NWE NAPHTHA CARGO SPECS

Specific Gravity at 15 C	max 0.735 g/ml	←
Reid Vapor Pressure	max 12.5 psi	
Colour	min +20 Saybolt	
Initial Boiling Point	min 30 deg C	
Final Boling Point	max 180 deg C	
Paraffins pct vol	min 65 %	←
Olefins pct vol	max 1 %	←
Naphthenes + aromatics pct vol	balance	
Sulfur	max 500 ppm	
H2S	max 10 ppm	
Lead	max 50 ppb	
Organic chlorides	max 3 ppm	←
Total chlorides	max 10 ppm	←
MTBE	max 50 ppm	
Total Oxygenate	max 100 ppm	←
Mercury	max 5 ppb	
Mercaptan sulphur	to be reported	

# C-PPO QUALITY

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## Waste plastic quality

- Bulk plastic composition (PE/PP/PS etc.)
- Plastic cleanliness

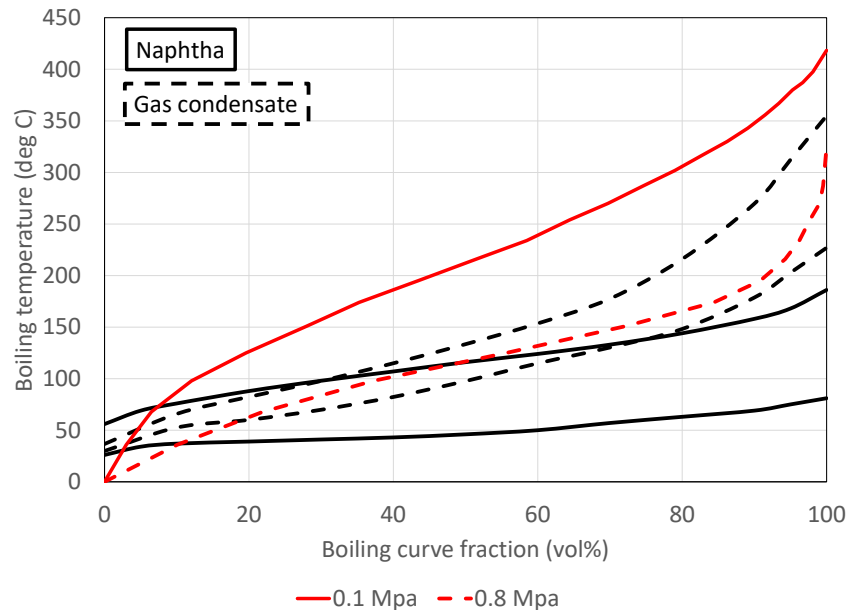
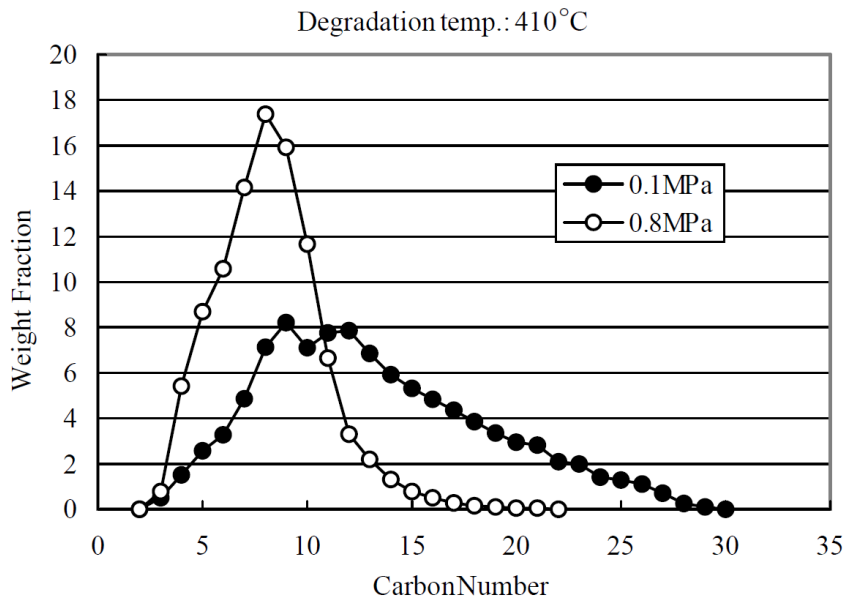
## Processing

- Reactor type
- Processing conditions (P, T, residence time)
- Use of catalyst / other additives
- Heat transfer motif / heat transfer medium

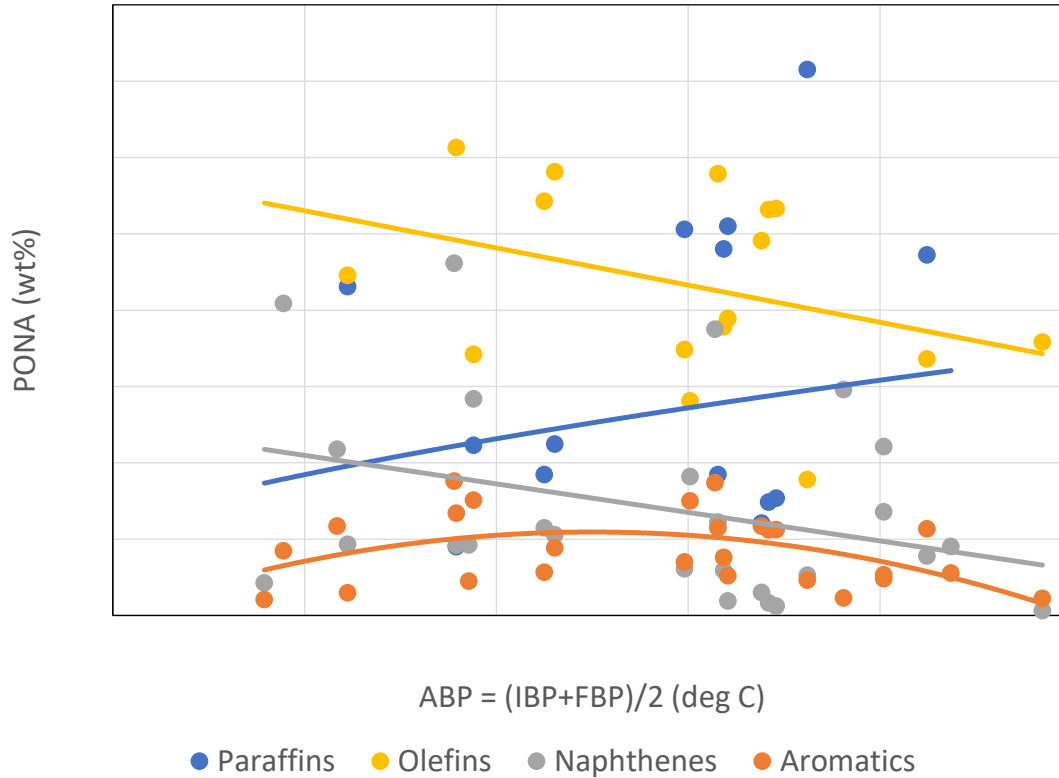
Crude  
PPO  
quality



# PLASTICS PROCESSING IMPACT ON C-PPO BOILING CURVE DISTRIBUTION



# CRUDE-PPO QUALITY VS. BOILING RANGE (1)

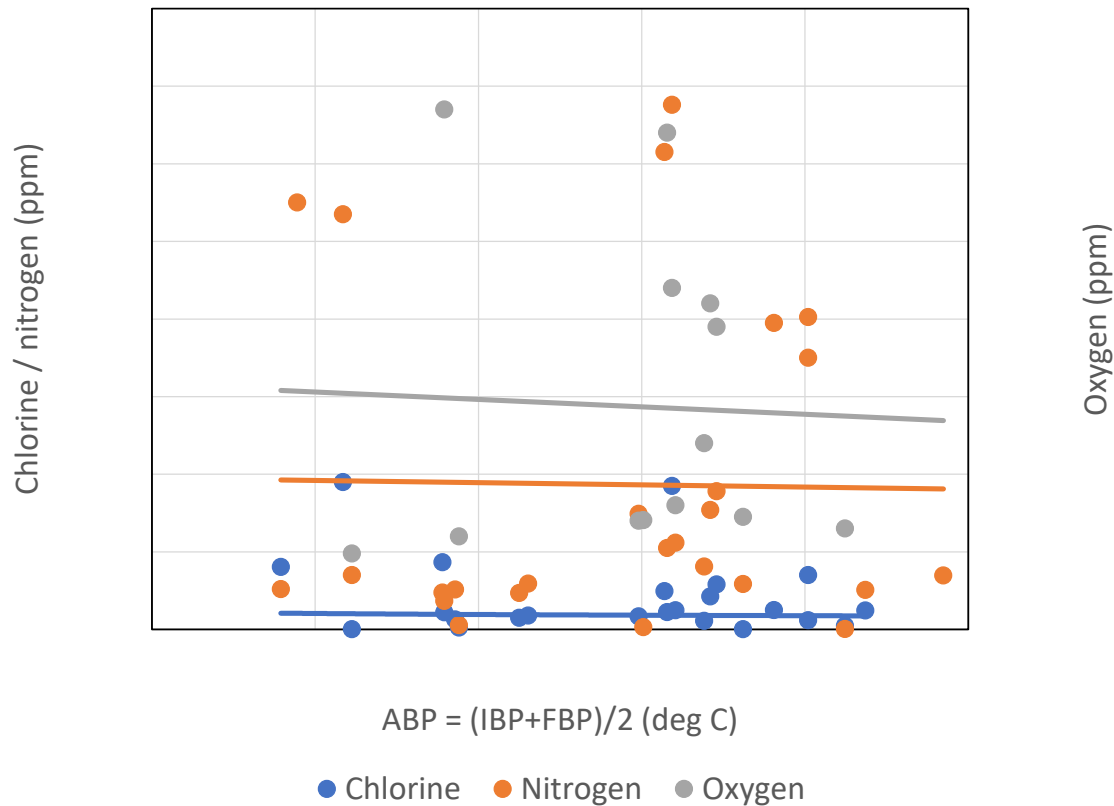


- Naphtha specification:
- Paraffins – min 65%
  - Olefins – max 1%

Note: lines are added for indicative purposes only



# CRUDE-PPO QUALITY VS. BOILING RANGE (2)



- Naphtha specification:
- Chloride – max 10 ppm
  - Oxygenate – max 100 ppm

Note: lines are added for indicative purposes only





# RISKS OF USING CRUDE PPO AS FEEDSTOCK

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## Olefins, naphthenes and aromatics

- Gum formation
- Product yield
- Process fouling

## Heteroatoms (N, O, Halides)

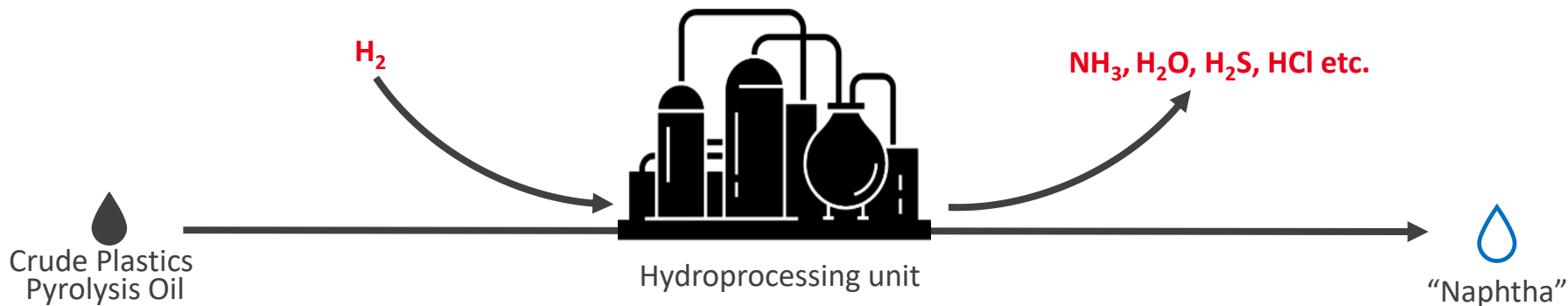
- Corrosion
- Catalyst poisoning
- Off-spec product

## Metals (Fe, Na, Si, etc.)

- Fouling
- Corrosion
- Catalyst poisoning



# CRUDE PPO REFINEMENT VIA HYDROPROCESSING



## Hydrogenation

(Di)-olefins → Paraffins

Aromatics → Naphthenes

HydroDeSulfurization (HDS)

HydroDeNitrification (HDN)

HydroDeOxygenation (HDO)

HydroDeChlorination (HDCI)

HydroDeMetallization (HDM)



# RISK OF C-PPO HYDROPROCESSING

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## (Di)-olefins

- Gum formation
- Fouling
- Excessive heat formation

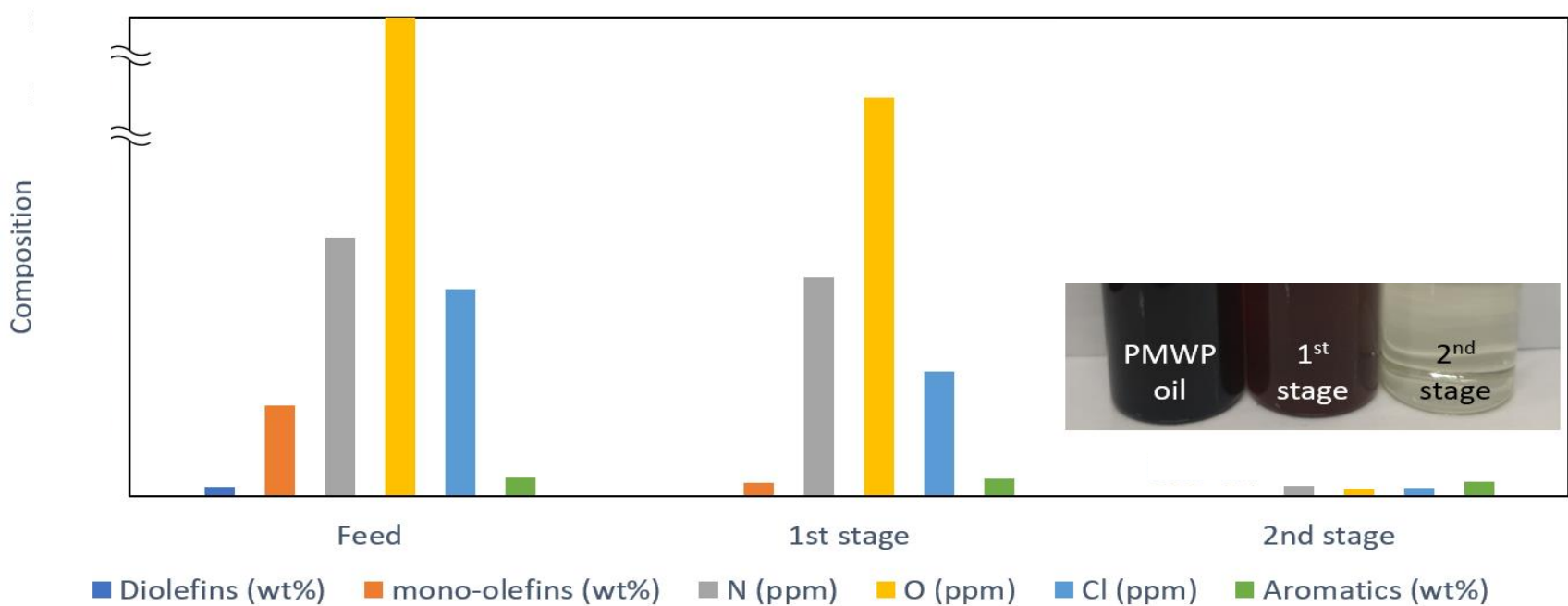
## Heteroatoms (N, O, Halides)

- Corrosion – HCl/HF/HBr/H<sub>2</sub>S
- Catalyst poisoning
- Fouling – NH<sub>4</sub>X precipitation

## Metals (Fe, Na, Si, etc.)

- Catalyst poisoning

# CAN HYDROPROCESSING DO THE NECESSARY REFINEMENT?





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