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Short Bio 1991~ ENEOS Oil company 2017~ Japan Petroleum Energy Centre	

Method Name in non-abbreviated full form.

Analysis of heavy oil components with Fourier transform ion cyclotron resonance mass spectrometry (FT-ICR MS)

Method description in brief.

Heavy oil components are analysed with the procedure of fraction technique, FT-ICR MS and Evaluation.

1. Pre-treatment

The sample is separated 7 fraction as Saturate fraction (Sa), 1 ring aromatic fraction (1A), 2 ring aromatic fraction (2A), 3+ ring aromatic fraction (3A+), polar resin fraction (Po), poly-aromatic resin fraction (PA), asphaltene fraction (As)

2. FT-ICR MS

- FT-ICR MS : Bruker, solarix 12T
- ionisation methods
 - APPI : 1A, 2A, 3A+, Po
 - LDI : Pa, As
 - Ag-LDI : Sa
- Introduction method
 - Spray injection : 1A, 2A, 3A+, Po
 - Target plate : Sa, Pa, As
- Detection method : ICR (Ion Cyclotron Resonance)



3. Evaluation

- Detective target : 10,000 over
- Results : List of all components, Double Bond Equivalent (DBE) Plot, Hetero class

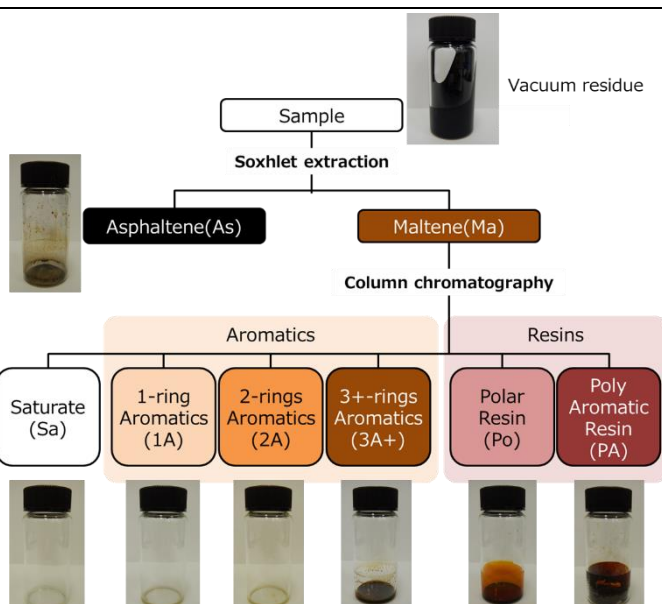
Applicability of method.

- Heavy oil components are analysed with this method.
Light oil like as Kerosene, Gasoil, Plastic recycle oil and Biomass oil are not covered.
- Carbon number/molecular weight range
: Carbon number 20~100/ molecular weight 250~1200
- Analysis target : Hydrocarbon as oil (Sa, 1A, 2A, 3A+, Po, Pa, As) , N, S, O, V
- Resolution : 500,000

Sample preparation required.

➤ Pretreatment

The sample is separated into 7 fractions as pretreatment.
The figure shows the method of pretreatment in detail.



Method strengths.

Tens of thousands of molecules can be detected.

Estimated time for analysis.

Pre-treatment : 1week FT-ICR MS : 2week Evaluation : 2week

Method weaknesses.

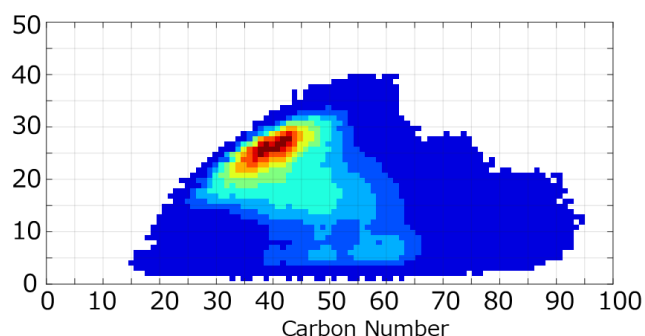
It takes time for pretreatment, FT-ICR MS, evaluation.

Result interpretation / visualisation / presentation.

1. List of all components

C	H	N	O	S	molecular formula	molar fraction
21	44	0	0	0	C ₂₁ H ₄₄	5.59E-05
22	46	0	0	0	C ₂₂ H ₄₆	0.000189

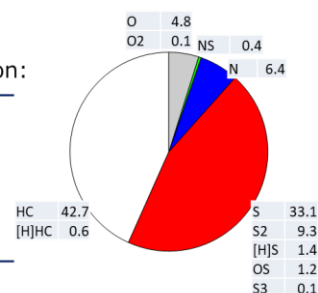
2. Double Bond Equivalent (DBE) Plot



3. Hetero Class

Definition of classification:

- HC ■ HC class
- S ■ SxOy classes
- N ■ NxOy classes
- NS ■ NxOySz classes
- O ■ Ox classes



Relevant Papers

S.Teratani, K.Katano, R.Tanaka, T.Nakamura, H.Inomata, J. Jpn. Petrol. Inst., 62, 272 (2019).
K.Katano, S.Teratani, T.Suzuki, R.Tanaka, H.Kato, K.Norinaga, Energy & Fuels, 35, 13687 (2021).

