Thermal Treatment Technology

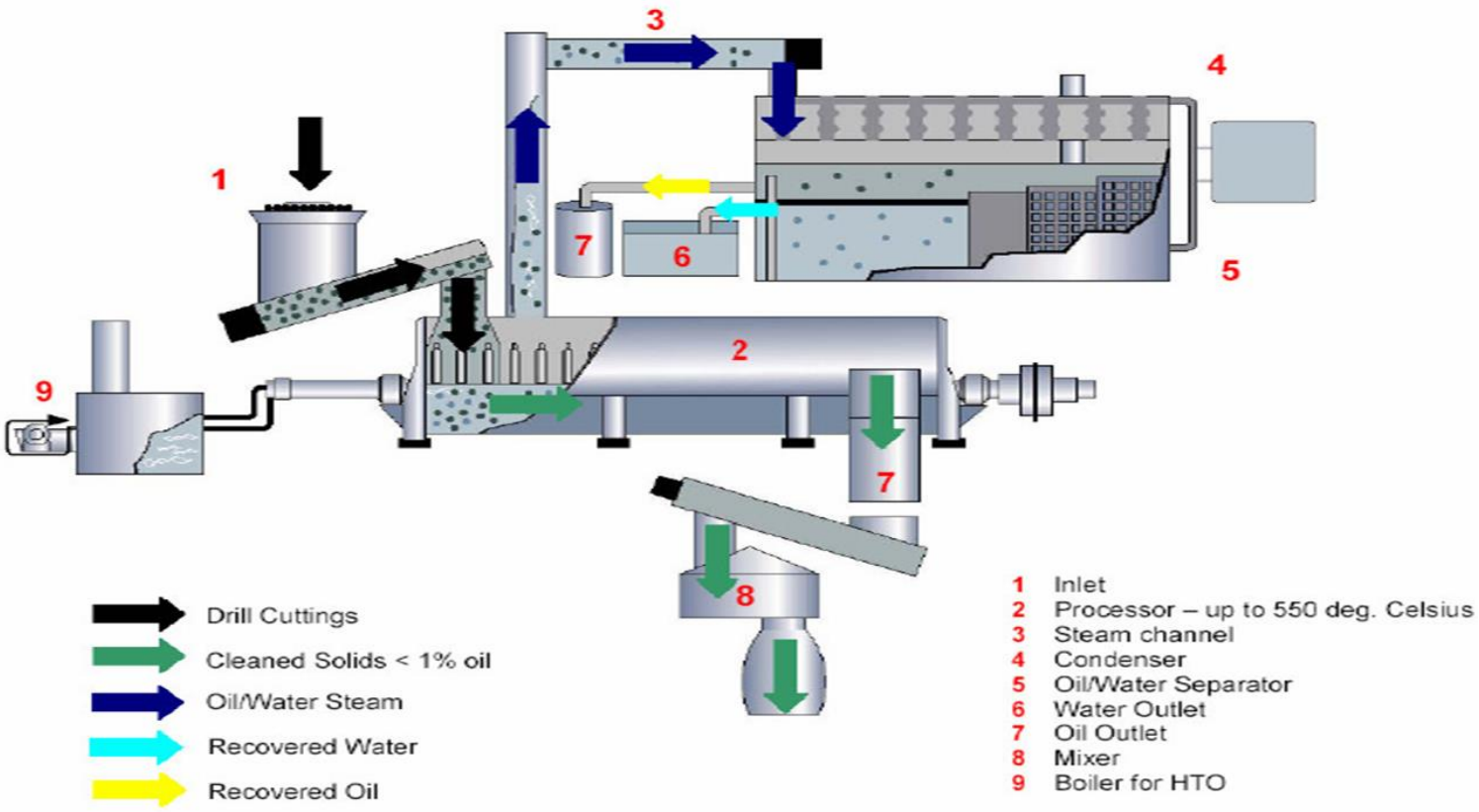
iNOVaTHERM™ Thermal Treatment Unit (TTU)

02/16/23

NOV Thermal Treatment Units Since 1990 With 34 Units Currently in Operation

	Current Projects	Completed Projects	
Onshore	Norway (11)	Azerbaijan (4)	Venezuela (3)
	Scotland (2)	UAE (2)	Kazakhstan (1)
	Netherlands (2)	China (1)	Algeria (1)
	Oman (1)	England (1)	Egypt (2)
	Nigeria (5)	Denmark (1)	Romania (1)
	Angola (7)	Bangladesh (1)	Colombia (1)
	Bolivia (1)	Gabon (1)	Mexico (1)
	Guyana (1)	Germany (1)	Nigeria (1)
	Abu Dhabi (1)	North Dakota (1)	
Offshore	UK North Sea (2) Norway North Sea (1)		

HTDU – Hot Oil Thermal Desorption Unit



iNOVaTHERM Thermal Treatment Unit

Benefits of iNOVaTHERM

- Higher throughput
- Safe, cost effective operation
- Reduced carbon foot print (ESG)
- Reduced energy cost
- Reduced liability
- Reduced HSE exposure
- Plug & Play
- Handles a wide variety of liquids/waste streams
- Commercial savings

iNOVaTHERM vs Hammermill

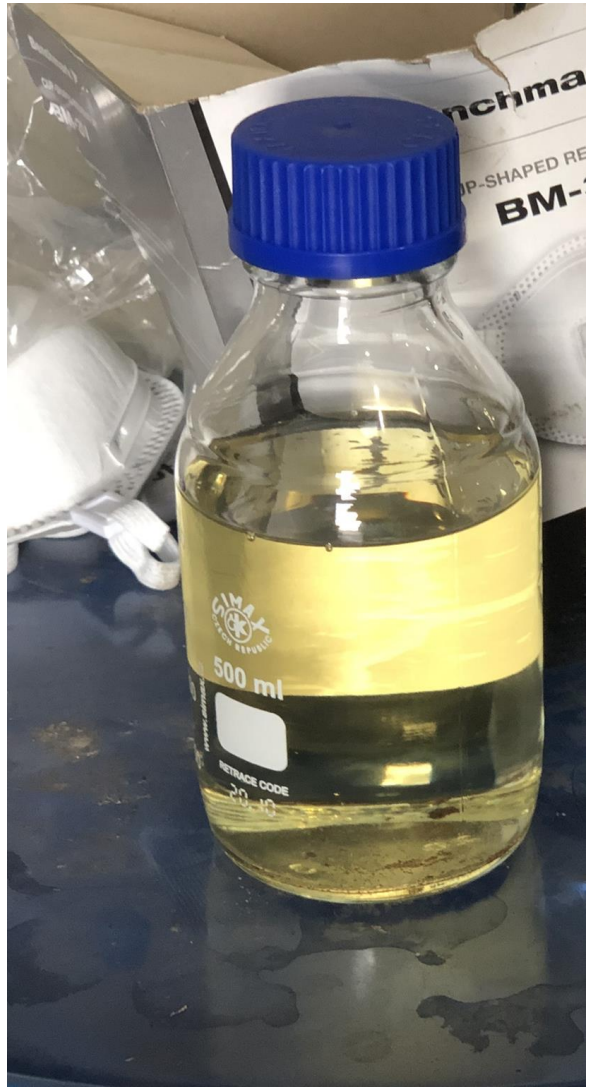
iNOVaTHERM

- 10-30% energy input from Turbulence Drive
- Majority of energy goes directly into heating cuttings. Lower energy per ton processed
- Higher throughput per footprint
- Utilizes multiple energy sources
- Can process a variety of liquid contents, slop, spent muds
- Rapid startup and cool down – can run day shift only if required
- Less wear and tear with parts easier to change
- Recovered oil quality – excellent
- Consistently lower TPH on solids

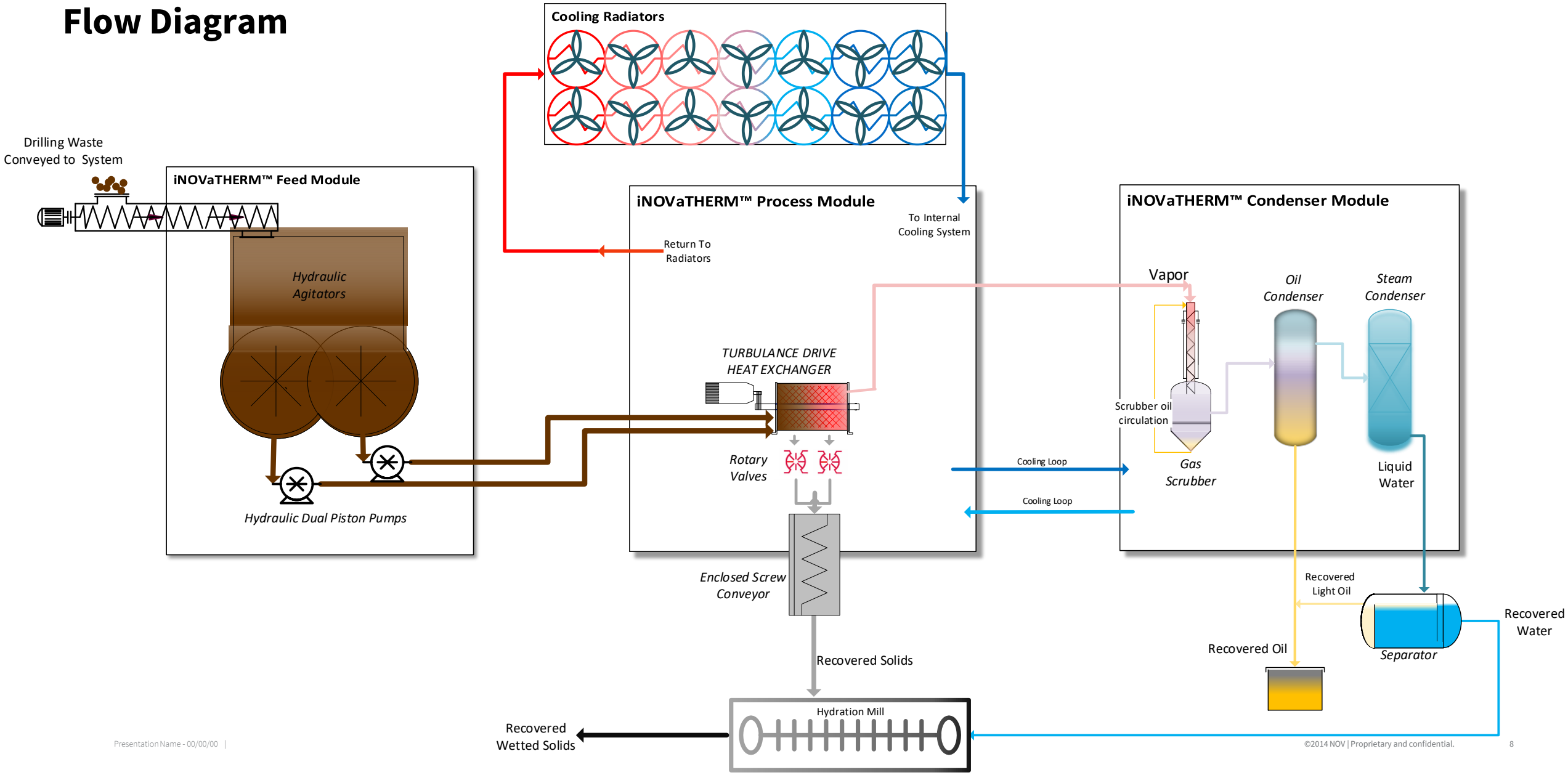
Hammermill

- 100% of energy from large engine / motor required to generate frictional heat, that in turn heats the cuttings (less efficient)
- Larger footprint, more modules
- Requires a certain percentage of solids to create frictional heat
- Process impacted by varying feed
- Slower to start up and create heat
- Higher maintenance (NPT) and wear due to reliance on friction
- Recovered oil quality – good, however can have high solids content from fine solids carryover

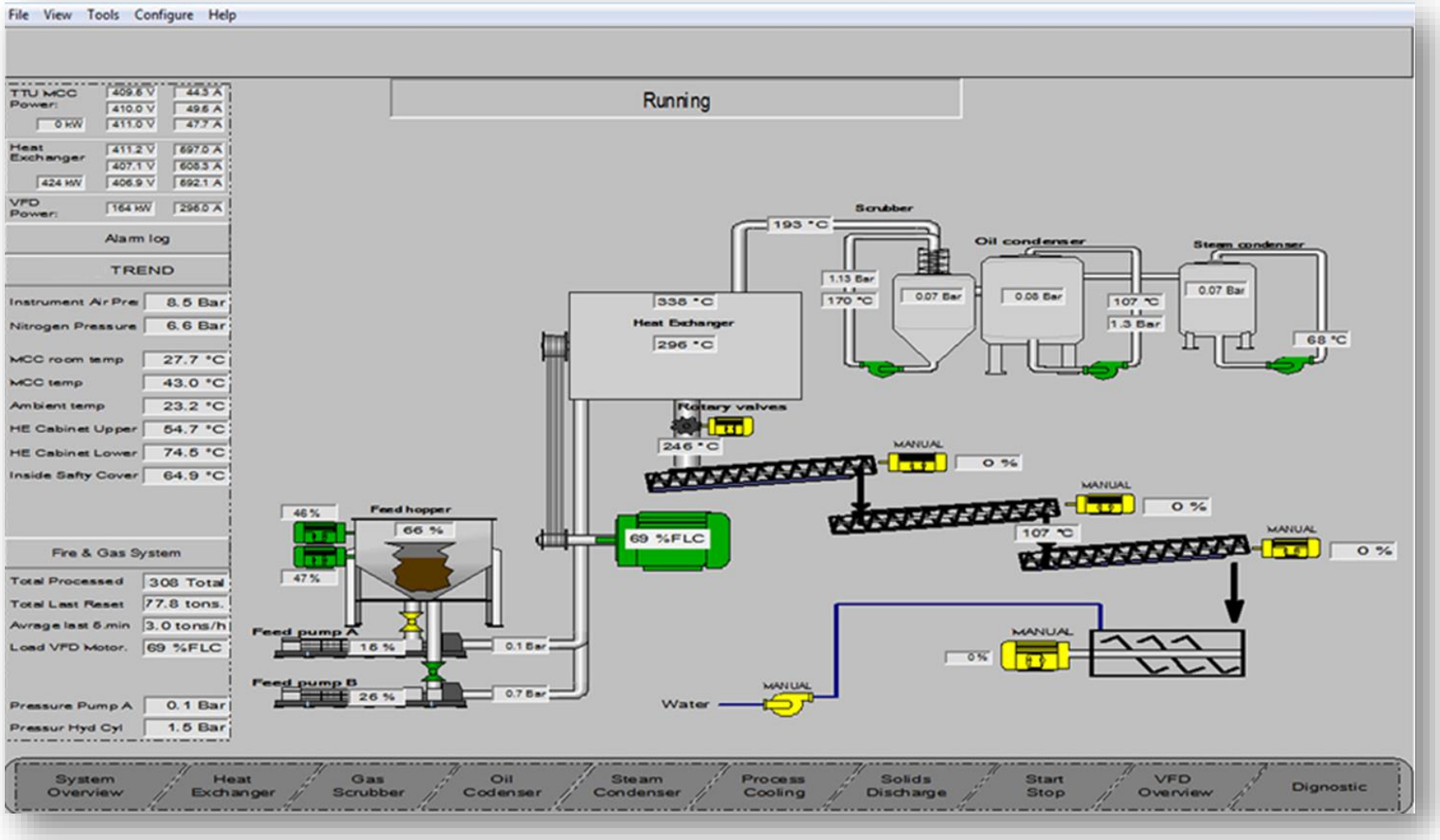
Processing



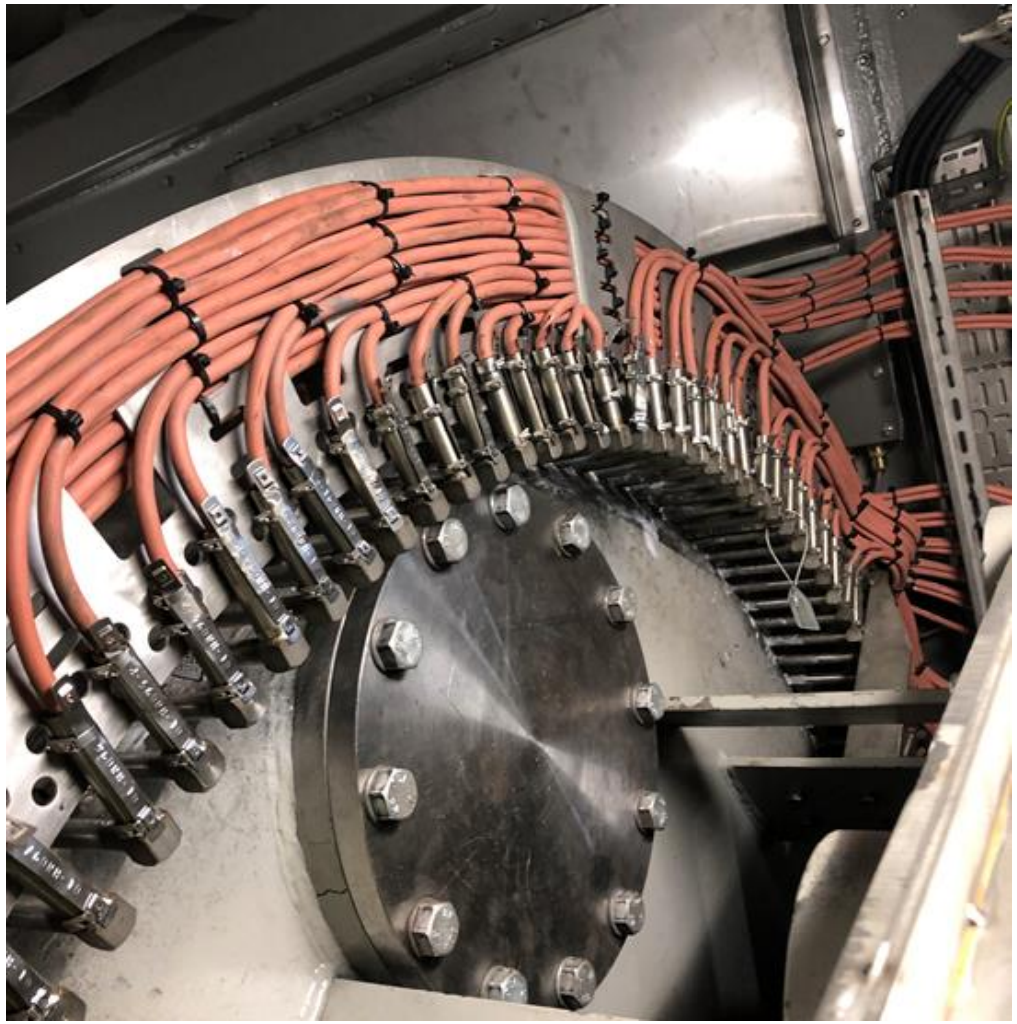
Onshore Flow Diagram



iNOVaTHERM Portable Treatment Unit



How it Works

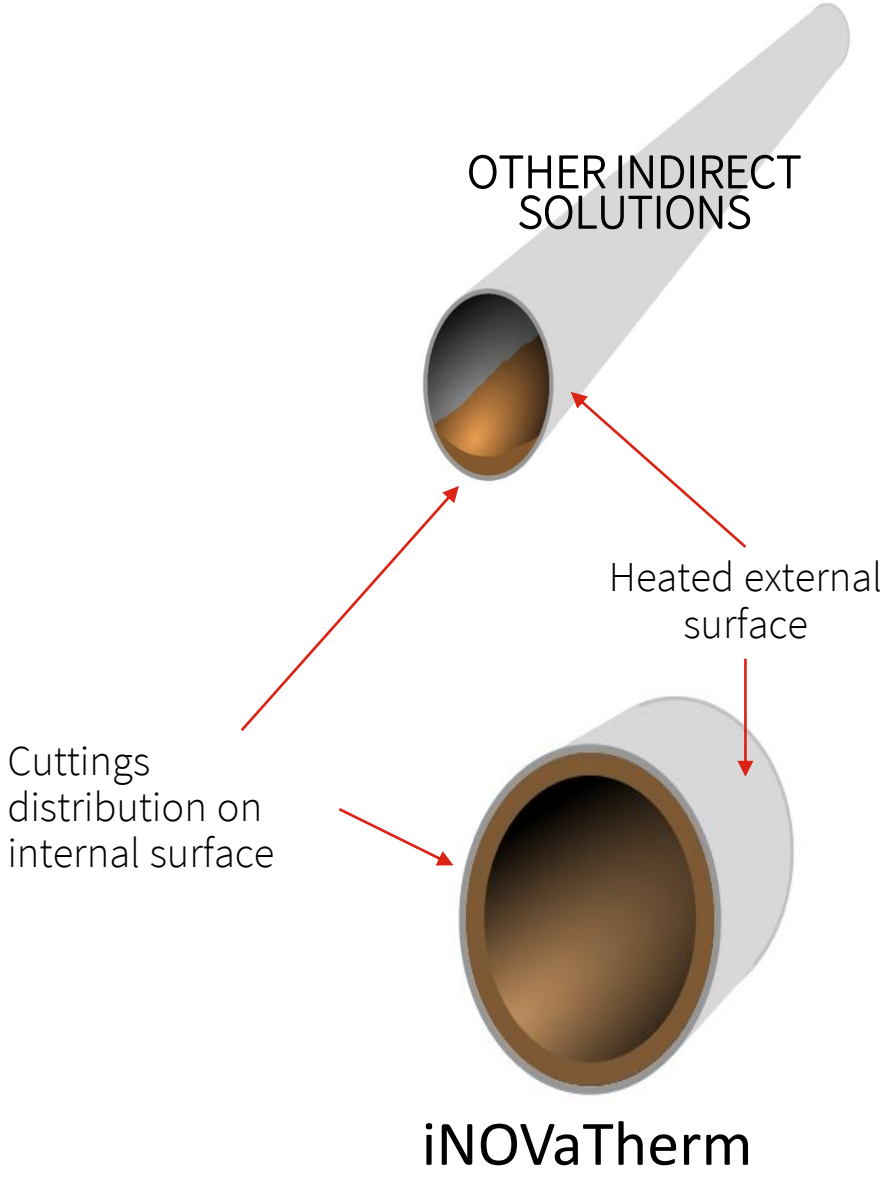


- Indirect Thermal Desorption
- 550 F
- Oil is not cracked
- <1% OOC

Efficient Utilization of Heated Surfaces

- **Traditional "Slow Moving" Indirect Solutions**
  - Cuttings are affected by gravity allowing only ~1/3 or less of the surface area to transfer heat into the cuttings
  - Available surface area of the heat exchanger is ~30%

- **The iNOVaTHERM Turbulence Drive**
  - Provides rapid replacement of solids
  - Surface area of the heat exchanger is 100% utilized
  - Reduced energy requirements



Recovered Oil

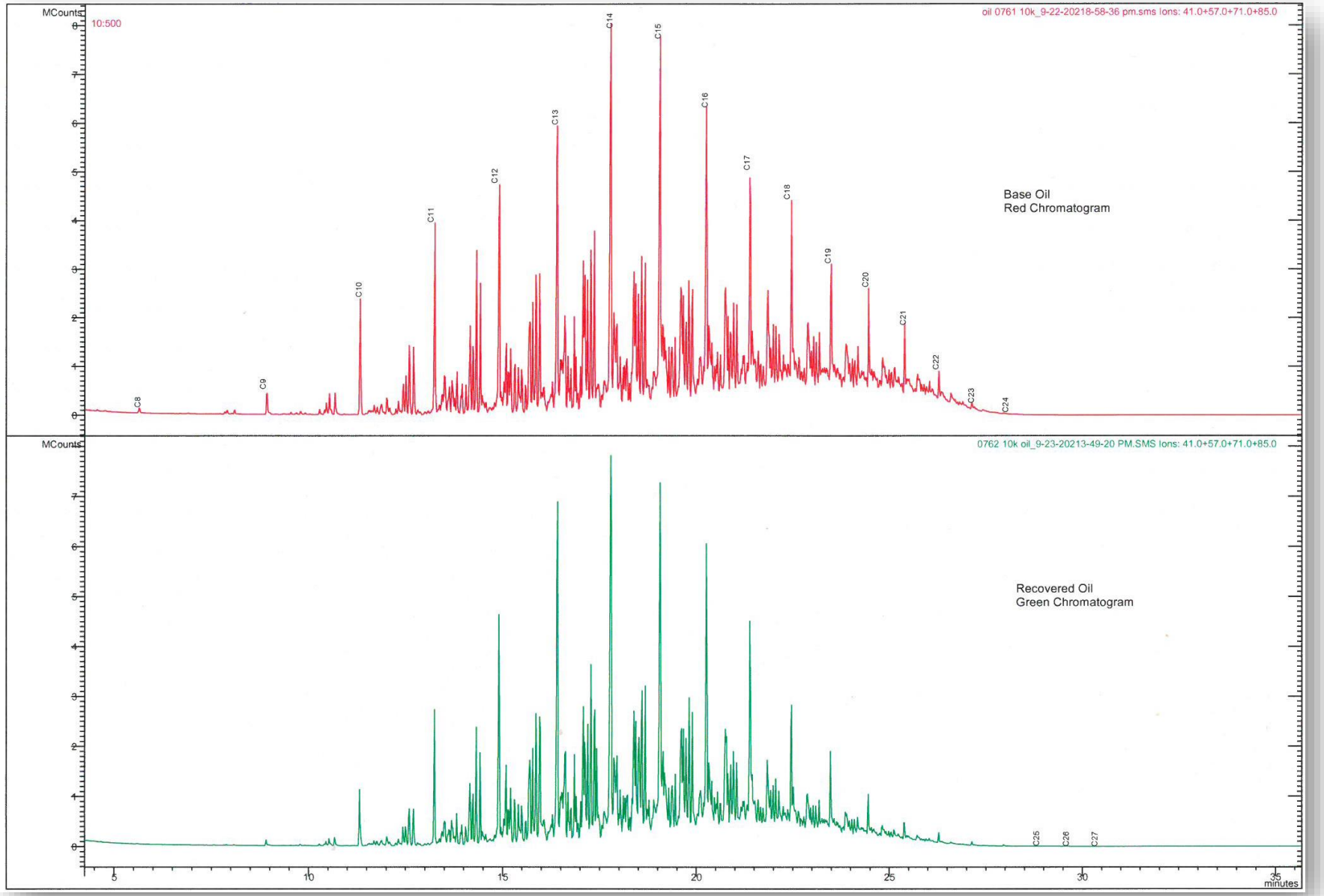
- Molecular structure is not changed
- Instantaneous Oil evaporation
- Suitable for reuse as a base fluid or recycled as a fuel for other processes
- Density of 0.81
- Slightly Yellow color with high clarity
- Identical gas chromatograph (GC) fingerprint compared to virgin oil

Recovered Oil Virgin Base Oil

Gas Chromatograph

Base Oil

Recovered Oil



iNOVaTHERM Specifications

- 1,500kW
- DNV approved
- Air cooled / water cooled options
- Electrical 400-690V, 50/60Hz
- ATEX zone 2 compliant
- CE marked
- NORSOK compliant option
- Remote monitoring / support
- 10’ and 20’ containerized options
- Modular

- Capacity with Drilled Cuttings
  - 1.5MW typical 8+MT/hr

  Based on 70/15/15% by weight solids/oil/water. Rates vary depending on waste composition
- Unit can also process slops waste and spent drilling mud handling feeds within the following ranges:
  - Solids content 40-80% wt
  - Base oil content 10-30% wt
  - Water Content 10-30% wt

ONSHORE LAYOUT EXAMPLE

OFFSHORE LAYOUT EXAMPLE

iNOVaTHERM Advantages

- Multi-energy source Indirect thermal desorption unit for efficient processing
- Compact and robust design
- Plug and play
- Small footprint
- Innovative non-frictional heating process
- Higher efficiency, lower maintenance, higher throughput
- Cleaner recovered base oil to rebuild mud
- <1% OOC