Resid Hydrocracking reactor bed density
Units that typically use Radiometric
- Desalters
- Alkylation
- Tower Bottoms
- Delayed Coker
- Resid Hydrocrackers
Experience

▪ Experience with
  ▪ Axens – H-Oil (Shenua, Bourgas, Sinopec, PKN, etc)
  ▪ CLG – LC-Fining (Eni/AGIP)
  ▪ Eni’s – EST (Sannazzaro)
  ▪ KBR – VCC (Taif)
▪ 14 out of the 25 operating units
  ▪ 5 of the last 7 projects
Vessels with Radiometric

▪ Reactors
▪ Separators
▪ Catalyst Handling/Transfer
▪ Towers/Columns
▪ Using Drilled Bore
  ▪ Reactors
  ▪ Liquid/Vapor Separators
    ▪ High Temperature and High Pressure
  ▪ Catalyst Transfer Vessels
▪ Using Drilled Bore
  ▪ Reactors
  ▪ Liquid/Vapor Separators
    ▪ High Temperature and High Pressure
  ▪ Catalyst Transfer Vessels
Parameters
- Parameters
  - Depth of Bore hole (remaining wall thickness)
Parameters

- Depth of Bore hole (remaining wall thickness)
- Process Path (distance from wall to source well)
Parameters

- Depth of Bore hole (remaining wall thickness)
- Process Path (distance from wall to source well)
- Max Density reading
- **Parameters**
  - Depth of Bore hole (remaining wall thickness)
  - Process Path (distance from wall to source well)
  - Max Density reading
Typical operating densities

- Bed Density
  - 0-65kg/m³ – Vapor
  - 65- 500kg/m³ – Foam
  - 500-950 kg/m³ – hydrocarbon liquid
  - 800-1200kg/m³ – hydrocarbon liquid and catalyst (ebulliated/suspended)
  - 1200-1400+kg/m³ – Slumped bed
Vapor 0-65kg/m³
Foam 65-500kg/m3
Oil  500-950kg/m³
Oil/Catalyst  950-1600kg/m3
- Level Control
  - Too Low
    - Slumping of the bed (bed compression)
    - Poor distribution of catalyst
    - Can create “hot spots”
  - Too High
    - Catalyst carryover
    - Pump damage
    - Long repair time
▪ Advance Controls
  ▪ Vapor/Solids Holdup Calculations
    ▪ Increased Unit Performance
    ▪ Increased Unit Reliability
  ▪ Needs Better Resolution
Making Density Measurement
Parameters - Fixed

- Distance from Detector to Vessel wall
- Insulation Thickness
- Process Path
- Source well thickness
- Distance from source to well wall
Making Density Measurement

Parameters - Variable

- Process Density
  - Calculate Absorption

\[ \Delta I = e^{-\mu \Delta \rho t} \]

\( \mu \) = Absorption Coefficient
\( \rho \) = Material Density
\( t \) = Material Thickness
Making Density Measurement

- Density span – 0-1400kg/m³
- Source Size – 1000mCi Cs-137
- Process Path – 800mm

![Graph showing density measurements](chart.png)
Making Density Measurement

- Density span – 0-1400kg/m³
- Source Size – 1000mCi Cs-137
- Process Path – 700mm
Making Density Measurement

- Density span – 0-1400kg/m3
- Source Size – 1000mCi Cs-137
- Process Path – 700mm
Filtering
Filtering

![Diagram showing raw signal and filtered signal over time](image)
Filtering
Making Density Measurement

- Density span – 0-1400kg/m³
- Source Size – 1000mCi Cs-137
- Process Path – 600mm
Making Density Measurement

- Density span – 0-1400kg/m³
- Source Size – 1000mCi Cs-137
- Process Path – 600mm
Making Density Measurement

- Density span – 0-1400kg/m3
- Source Size – 500mCi Cs-137
- Process Path – 600mm

![Graph showing density measurement resolution](image-url)

**0-1400kg/m3 600mm 60sec TC**
Parameters effecting density measurement

- Process path (fixed)
- Density range (fixed)
- Size of Source
  - Increased source to increase resolution/decrease time constant
- Increase Time constant
  - Increased Time constant to increase resolution, but delays reading
- Detector Sensitivity
  - Higher sensitivity is the same as increasing the source size.
  - Increased Resolution/decrease time constant/reduce source size or keep existing sources
Thank you for your attention!!!!

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