



Background

- Older units have several multi-pass horizontal shell and tube type Combined Feed Exchangers in series
- Newer units have a smaller number of vertical shell and tube type Combined Feed Exchangers in parallel
- Combined Feed Exchangers are usually arranged with feed on tubeside and reactor effluent on shellside
- Hence tube leak typically results in tubeside fluid leaking to shellside (dilution of reformat with raw feed)
- Identifying which of several Combined Feed Exchangers in preheat train is leaking can be quite difficult

On-Line Leak Detection

- Regular, rigorous performance monitoring provides first indication of leaking Combined Feed Exchanger
- Check reactor bypass closed (all units) and swing header motor operated valves not passing (cyclic unit)
- Use kinetic model embedded in flowsheet simulator to compare actual v predicted reformat yield/quality
- For gasoline-producing units, a leak will normally result in a lower-than-expected reformats RONC
- For aromatics-producing units, a leak will normally result in higher-than-expected non-aromatic content
- If leak suspected, sample feed and reactor effluent at Combined Feed Exchanger outlet (each train)
- Cat reforming chemistry indicates C₆ naphthene dehydrogenation reactions approach 100% conversion
- Hence C₆ naphthene component balance can be used to estimate leakage rate
- For units with no limits on reformat benzene content, use cyclohexane balance (product vs feed)
- For units with benzene precursors removed from feed, use methyl-cyclohexane balance instead
- Normal nonane (n-C₉) reactions also approach 100% conversion
- n-C₉ content is easier to quantify on gas chromatograph output trace than C₆ naphthene content
- Hence n-C₉ balance is an easy way to validate leakage rate estimated by C₆ naphthene balance
- Chemical (e.g. iodo-benzene) or radioactive tracers confirm leakage and can help estimate leakage rate
- Chemical tracers do not require special licence but need multiple sample points to identify leaking bundle
- Radioactive tracers require special licence but do not require sample points (external detectors)
- Appropriate placement of detectors is very effective way to identify single leaking bundle in preheat train

Off-Line Leak Detection

- Removing channel end cover and applying hydrotest to shellside identifies leaking tubes within a bundle
- However this technique can extend downtime because of requirement to drain and dry bundle after test
- Alternative approach is to insert rubber bungs in each tube and apply low helium gas pressure to shellside
- Since helium invisible, remove 1 rubber bung at time and use portable helium-specific mass spectrometer