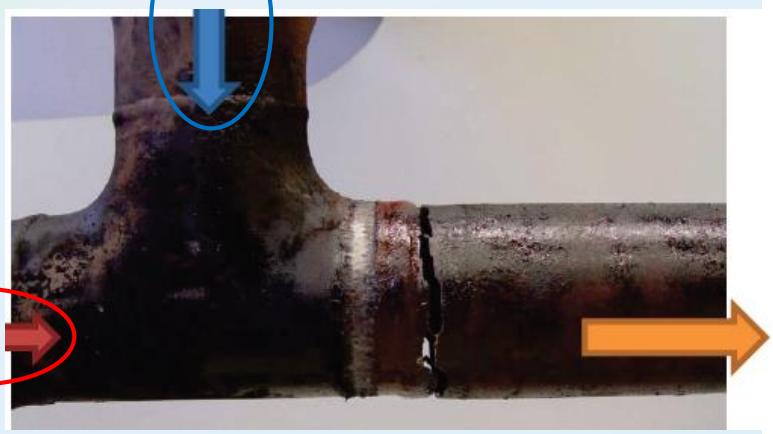
Fatigue stress cracking

EPSC Learning Sheet March 2020

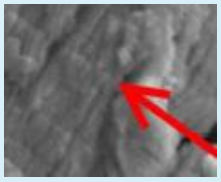
EPSC

<u>What Happened</u>:
Just after the point where two liquids with different temperature met in a 80 mm stainless steel line, the tube fully ruptured, after only 6 weeks in use, causing a release and an explosion

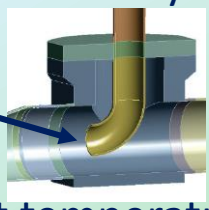


<u>Aspects</u>:

- The large temperature fluctuations in the tube led to high tensions, cracks, and full rupture of the pipe
- The mechanism can be confirmed by Scanning Electron Microscopy of the ruptured surface



- CFD modelling estimated temperature swings to be above 120 K, that induced the rapid formation and growth of cracks from inside, that ruptured the tube
- The pipe was made out of austenitic SS 316, other alloys would probably not have helped
- Good mixing design with central tube inlet can reduce temperature fluctuation



- Be cautious when mixing liquids with different temperatures
- Inspection can not really help, only good design

Large temperature fluctuations can induce Fatigue Corrosion