UNENE Graduate Course
Reactor Thermal-Hydraulics Design and Analysis

McMaster University
Whitby
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Flow Instabilities

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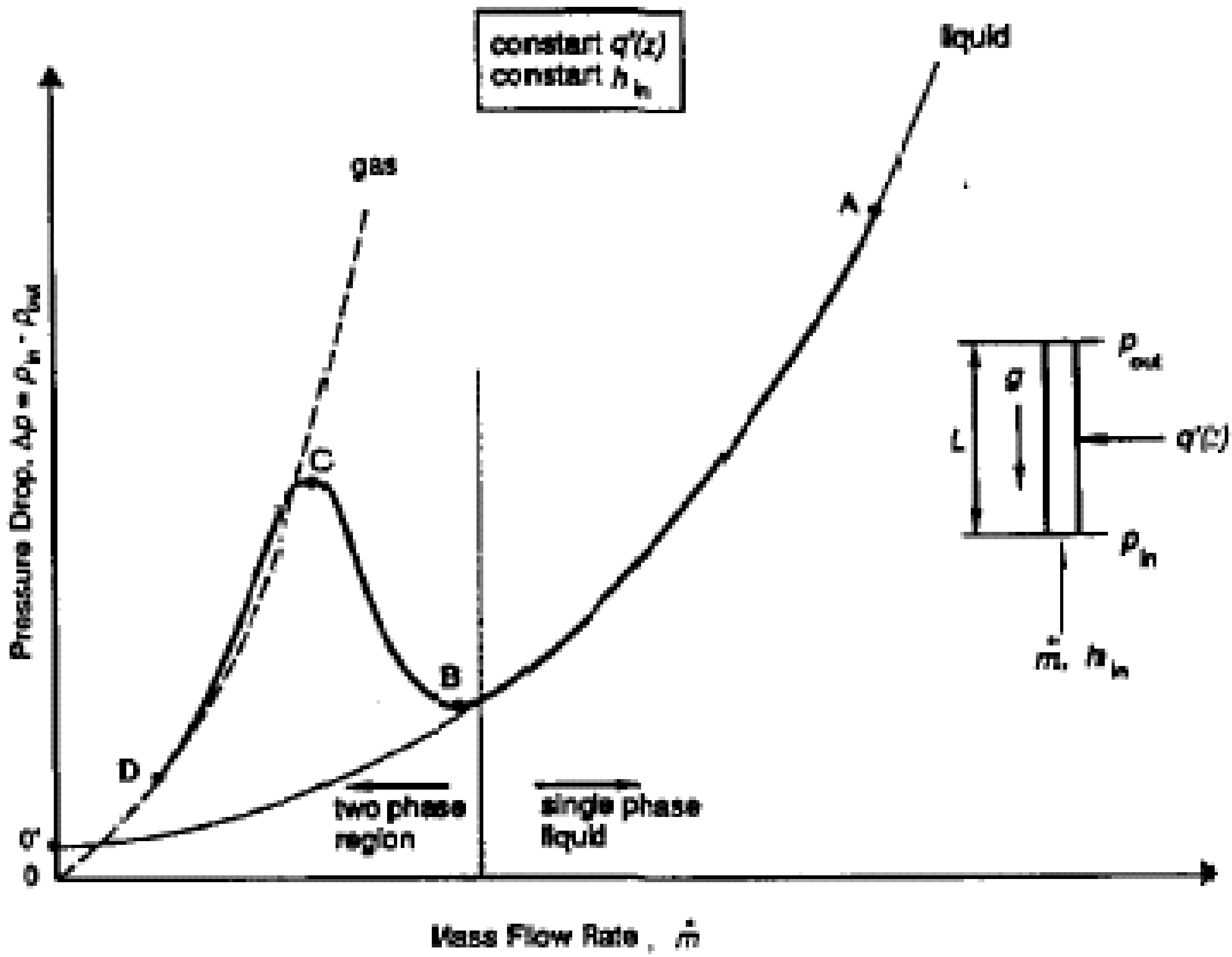
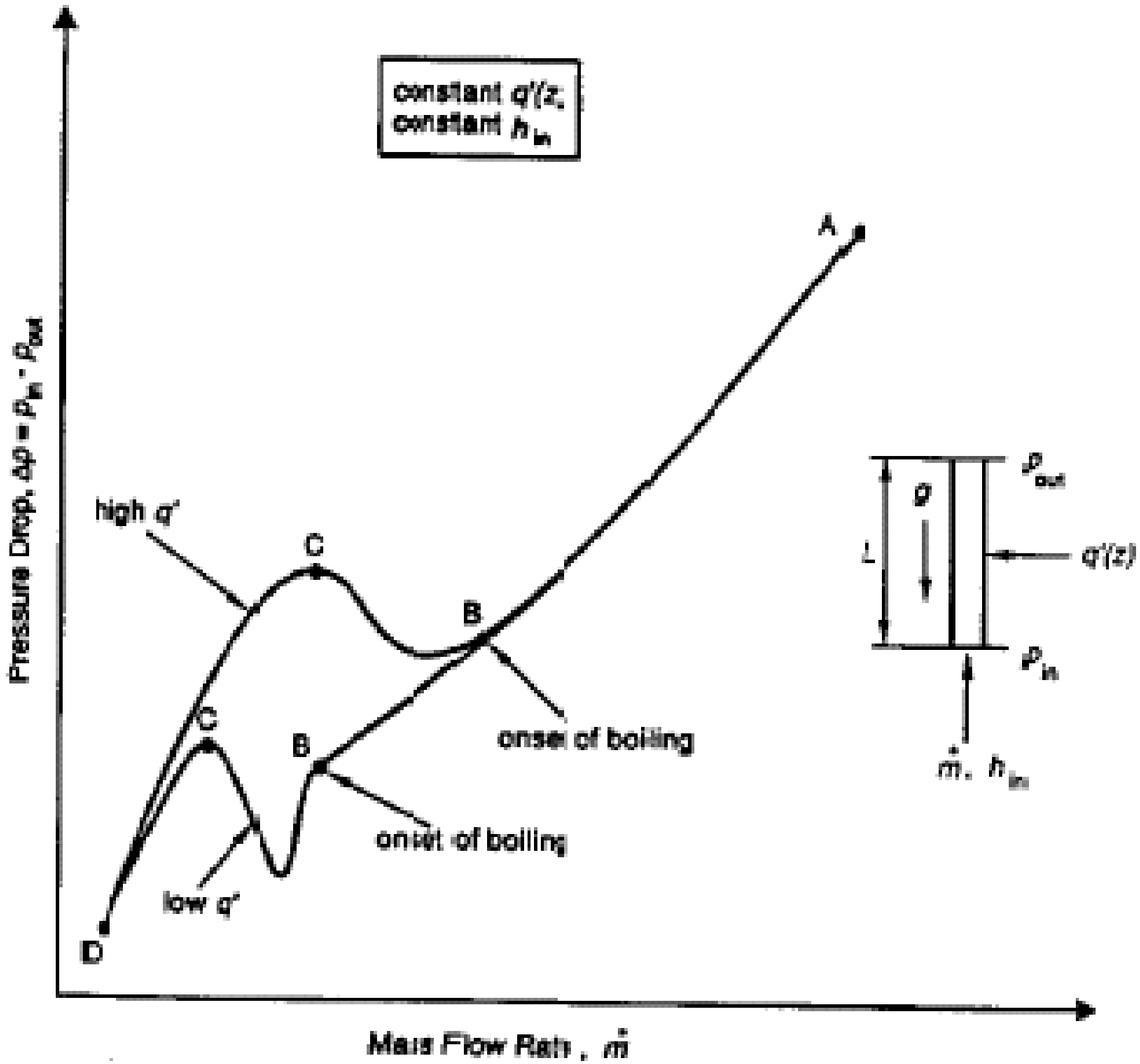
Flow Instabilities

- Understanding flow instabilities is instrumental to ensuring good understanding of thermal-hydraulics system behavior
- Scale-based grouping
  - Microscopic instabilities (occur locally)
  - Macroscopic instabilities (involve entire system)
- Process-based grouping
  - Static instabilities (unstable equilibrium states)
    - <u>Flow excursions (Ledinegg instability)</u>
    - Relaxation instabilities (flow pattern transitions, nucleation instabilities, bumping, chugging, and geysering)
  - Dynamic instabilities
    - Density wave oscillations
    - Pressure wave oscillations
    - Acoustic oscillations

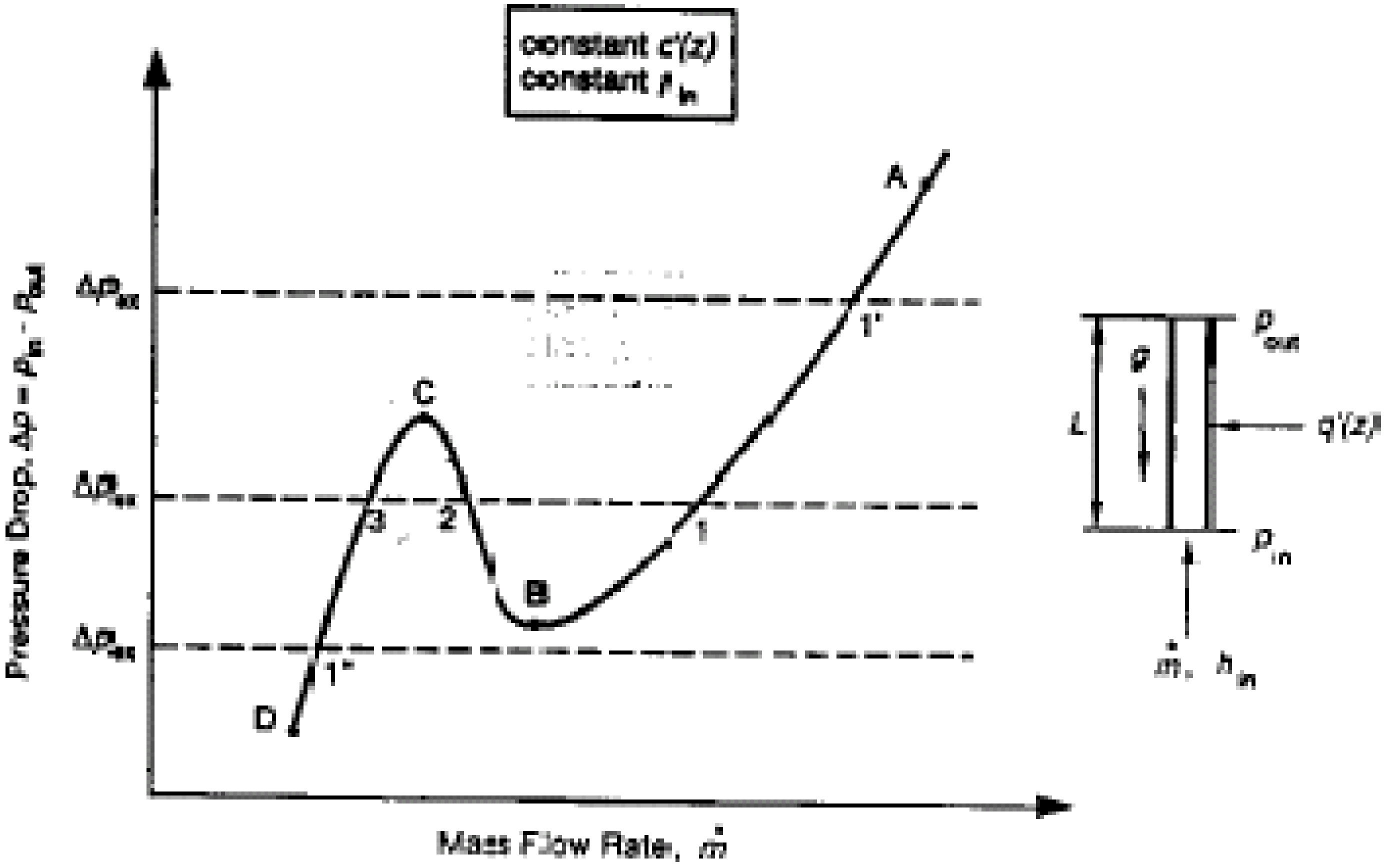
Flow Instabilities - Background



Flow Instabilities - Background



Flow Instabilities - Background



Flow Excursion Instability

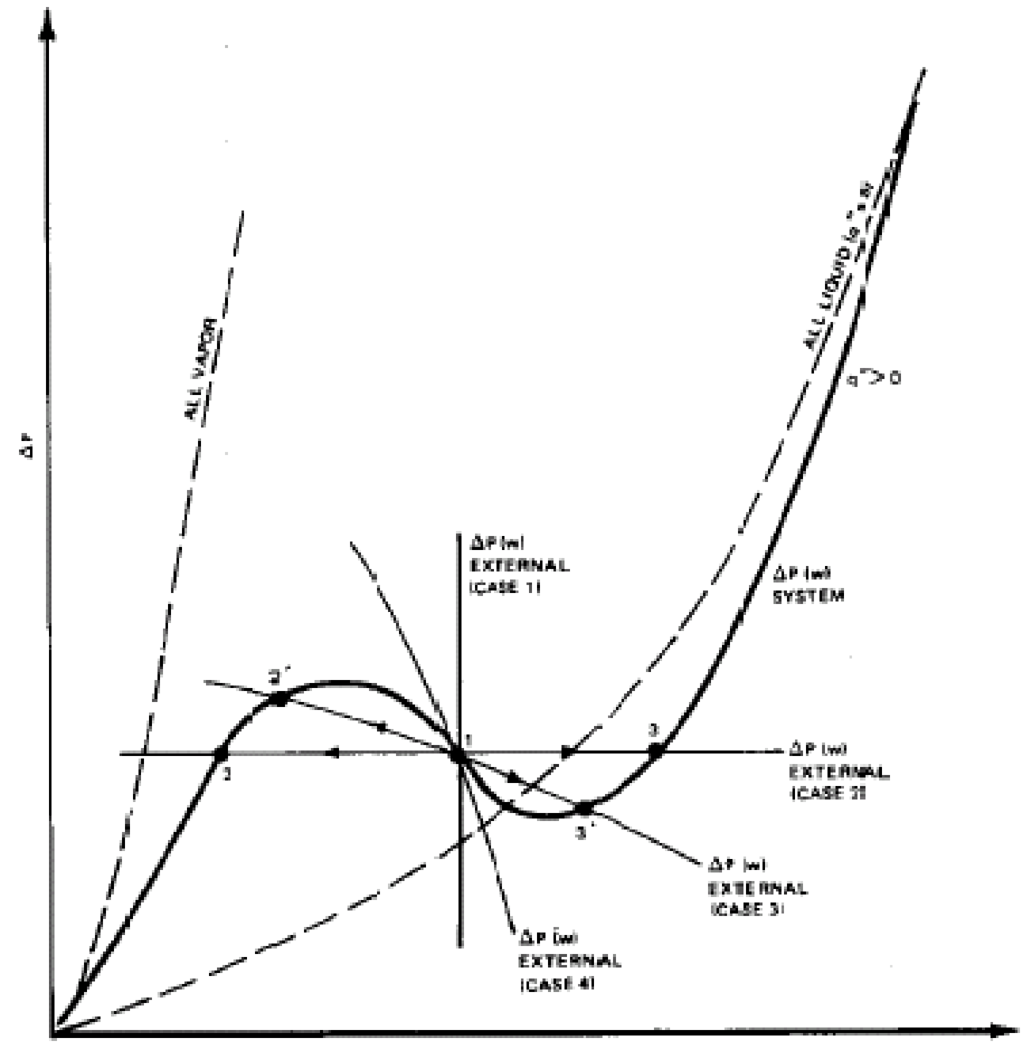


Fig. 7-1. Excursive instability.

$$\frac{\partial(\Delta p_{system})}{\partial w} > \frac{\partial(\Delta p_{ext})}{\partial w}$$

Case 1 – positive displacement pump

Case 2 – parallel channel situation

Case 3 – centrifugal or jet pump situation

Questions?