Upgrading the IEC41 code with respect to acoustic discharge measurement

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IEC 41: Acoustic discharge measurement: transit time method (time of flight)

- Secondary method → primary method
- Integration technique
- Application limits
- Installation issues

Primary method

Time has come for an upgrade (1991)

- **Many years of experience (learned our lessons)**

- **Positive features**
  - **- continuous flow measurement (best practice requirement)**
  - **- little degradation of components**
  - **- stable operation, good accuracy**

- **Technological advance for acoustic measurement methods**

Integration technique I

- **As today: Gauss-Jacobi for circular and Gauss-Legendre for rectangular section for 4-paths in one plane and uniform velocity distribution**

- **Inclusion of positions and weights for turbulent velocity profile**

  - circular sections → OWICS (Optimal Weighted Integration for Circular Sections) Voser [1999], Tresch et al [IGHEM 2006]

  - rectangular sections → OWIRS (Optimal Weighted Integration for Rectangular Sections) Lüscher et al [IGHEM 2008]

Integration technique II

- **Table for arbitray path numbers from 2 to 9?**

- **Inclusion of correction formula for non-ideal path positions**

  - generic presentation and table for important cases

  Tresch et al [IGHEM 2008]

- **Procedure of how to calculate the flow in non-ideal crossed path configurations (path parameters of crossed paths not equal)**

Application limits I

- **Influence of protrusion**
  - **- formula**
  - **- error range as a function of velocity, path length and sensor length**

- **Limits of application expressed by the product L(or D)*v**
  - **- Table for certain values of L and v**

L*v = const → same accuracy

Application limits II

- **Limits of applications expressed by difficult flow conditions**

  → Under what conditions increasing the number of paths does not help anymore?

  Lüscher et al [Hydro 2007]

- **In which cases simulation studies can help?**

- **Effect of particles and air bubbles?**

Installation Issues

- **Distinction between pump and turbine operation**
  - effects of obstacles up- and downstream
  - Table with recommended distances from obstacles

- **Orientation of path planes with respect to pipe axis for most important applications**