Session E9: Incorporating Fish Friendly Solutions in Existing Pumping Stations; An Economical Solution Enabling Fish Migration

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Incorporating fish friendly solutions in existing pumping stations;
An economical solution enabling fish migration

Fish Passage 2015
By: Lars Krakers
Date: June 20-24, 2015
Location: Groningen
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3. Fish Friendly Project
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   • Validation
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1. Introduction

For survival of many fish species migration between different wetlands is a necessity. Many pumping stations prove impassable barriers.

Example Eel: Wetlands ↔ Sargasso Zee

Increased focus on environment:
- European/local laws on enabling fish migration through barriers.
- Fish friendly market

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www.sportvisserij.nl
2. Philosophy

Solving fish migration barriers:

1. Add fish passages:
   - fish stairs, fish siphons
   - Expensive (extra civil works)
   - Introduces leakage

2. Solutions to prevent fish entering pumps:
   - stroboscopic lights, acoustic barriers, fixed screens, bubble curtains
   - No migration → Combination with fish passage systems

3. Fish passable pumps
   - Relatively cheap (no extra civil works required)
   - Survival rates
2. Philosophy

Philosophy: “Bigger is better”

Pumping stations exist in a large variety in capacity but always have relatively low heads
Selection on purchase price → Pumps with small diameters and high speed; (axial impellers)

Fish friendly solution 1: Select pumps that are larger than required with relatively low speed
- Advantage: Fish Friendly, longer lifetime
- Disadvantage: Higher purchase cost

Fish friendly solution 2: Improve survival rates due to fish friendly design
# Project overview:

**Content:**

- Three parts:
  - Fish friendliness criterium
    - AJK 2015 Seoul, South Korea
  - Standard fish survival rate test method
    - call for participation in NTA by NEN institute
  - Validation with new fis friendly pump design

## Project duration:
31 aug 2012 – 1 feb 2015

## Subsidy RVO:
Biodiversity & Business framework

## Partners:
3. Fish friendly project

**Design:**

Axial hydraulic → BVOP/VOP/OVOP/SHG → BVOP

- **Head range**: 1m - 9m
- **Capacity range**: 0.5m³/s - 8m³/s
- **Best efficiency rates**: 80%
- **Diameter range**: 0.35m - 1.25m
- **Speed range**: 750rpm – 150rpm

**Typical survival rates:**
- Eel (50cm): 40%
- Scale fish (20cm): 40%

![Diagram of fish-friendly project components]
3. Fish friendly project

Design:

Impeller redesign targets:
- Less vanes
- Straight → forward swept leading edge
- Minimum pressure drop (cavitation)
- Low speed
- High efficiency
- No gaps (Open/Closed impeller)

Constraints:
- Fit existing pumps/Motor power

Patented
3. Fish friendly project

**Validation:** Hydraulic performance model test

Only 3.5% efficiency reduction at BEP

Pressure side cavitation

Suction side cavitation
3. Fish friendly project

**Validation:** Prototype CVPS-F 85
3. Fish friendly project

**Validation:** Fish friendliness tests: 3 different heads
3. Fish friendly project

**Validation:**

- Sensor fish test

- Live fish test results: survival rates (after 72hrs)

<table>
<thead>
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<th>Rpm</th>
<th>Eel 1m</th>
<th>Eel 3m</th>
<th>Eel 4m</th>
<th>Roach 1m</th>
<th>Roach 3m</th>
<th>Roach 4m</th>
<th>Perch 3m</th>
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Pumping station Berkel: BVOP 85 → CVPS-F 85
(Duty: 6300m³/hr, Head: 2.27m)
4. Examples: Ropta

**Pumping station Ropta:** SVO 105-110 → VOP-F 105-110 (Duty: 10800 m³/hr, Head: 1.6 m)

- New 2 vane impeller + wear ring
- New engineered 3-vaned diffuser
- Existing 4 vane impeller + 9 vane diffuser

Experience In Motion
4. Examples: Miedema

**Pumping station Miedema:** SVO 140-140 → VOP-F 140-140 (Duty: 18900 m³/hr, Head 1.9m)

- **Waddenzee**
- **North-East Friesland**
- **Existing pull-out with 4 vane impeller and 9 vane diffuser**
- **New diffuser test mounted**
- **New pull-out with 2 vane impeller and 3 vane diffuser**

(Tour 2: “Fishways & Tidal Barriers” will visit pumping station Miedema on Thursday June 25th)
5. Conclusions

• Pumping stations with large pumps are already fish friendly

• Fish passable pumps are a cost effective solution to solve fish migration barriers caused by pumping stations

• Successfully developed and tested a high specific speed hydraulic suitable for many critical pumping stations

• Retrofitting for fish friendliness is a cost effective alternative

• Initiative for fish friendly NTA by NEN

• First retrofit projects in practice

Questions?