The Vortex Flow Insert
Effective Odor Control for Manholes and Pumping Stations
Why do Sewer Drops Smell?

- Hydrogen sulfide (H$_2$S) and other dissolved compounds in sewage tend to escape as gasses in turbulent areas.
- The flow pattern of a standard drop structure forces air upwards out of the manhole.
- Sewer gasses are extremely odorous even at very low concentrations.
H$_2$S Causes...

- Odor complaints and lawsuits from affected residents and businesses
- Corrosion of concrete and metal sewer system components
- Difficulties entering facilities such as pump stations due to dangerous gas concentrations
- Confined-space entry deaths
Current Solutions

• Vapor phase treatment – cleaning the gas out of the air
  – Biofilters
  – Wet scrubbers
  – Carbon adsorption

• Liquid Phase treatment – preventing the gas from forming
  – Chemical injection
  – Vortex Flow
The Vortex Flow Solution

• A specially engineered fitting that eliminates gas generation in sewer drops
• Uses the energy of the falling sewage to suppress turbulence and aerate the flow
• Winner of the 1999 APWA Technical Innovation Award
The Concept

- The influent line flow is accelerated in the Vortex Form
- Sewage is “spun” as it enters drop pipe and forms a vortex (whirlpool) all the way down
- Air core forms
The Secret

- Air core has slight negative pressure
- Gases sucked down to manhole bottom
- $\text{H}_2\text{S}$ not oxidized in air core is re-entrained in mixing pool
- Mixing pool aerates wastewater
Improves Wastewater Quality

• Influent is typically high in dissolved H\textsubscript{2}S and low in dissolved oxygen
• Effluent is high in dissolved oxygen and low in dissolved H\textsubscript{2}S
• Effective aeration
Is the Vortex Effective?

- The City of Minneapolis has been a pioneer
- First Vortex Flow installed on Humboldt Avenue South
- Manhole is located downstream of the discharge of a 27,000 ft. forcemain
- Manhole has a 15 foot drop
- Average daily flow of 3.3 MGD
Case Study

- Manhole was a constant source of odor complaints over the years
- Upstream 30” concrete pipe corroded and had to be repaired twice - in 1989 and 1996
- Chemical injection system installed in July 1997.
The Problem with Chemicals

• Chemical system had an underground 5000 gallon tank, and two chemical pumps
• From 60 to 80 gallons of Bioxide™ were injected daily to oxidize H₂S and control odor at the drop
• Chemical expenses averaged $5,700 (USD) per month
Vortex Flow to the Rescue

- Installation done in November 1997
- Two phase H$_2$S monitoring done in two locations:
  - Chemical feed on, no Vortex Flow
  - Chemical feed off, Vortex Flow installed

Bioxide shows higher final H$_2$S concentration
Better than Chemicals

Manhole

H$_2$S = 2.88 mg/L
DO = 1.05 mg/L

H$_2$S = 0.93 mg/L
DO = 4.57 mg/L

H$_2$S reduced 70%
DO increased 435%
And Cost Effective

Economic Comparison - Vortex Flow vs. Chemical Injection

Net Present Value
10 year life cycle

Vortex Flow  Ferrous Sulfate  Bioxide  Hydrogen Peroxide
Design Parameters

- Vortex size based on peak flow
- Vortex structures can handle large flows – 100 MGD and more
- Design can handle highly variable flow
- Effective at drop depths between 3 and 100 feet
- Most effective in drops 10 feet of more
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