

***“COVID-19 Modern Trash Loading Proves
Sewage Pump Clog Resistance Can Not Be
Predicted By Impeller Throughlet Size”***

Bob Domkowski
Engineering Consultant
Xylem, Inc. – Flygt Products

Do You Recognize Photos Like These?

Collection System Non-dispersibles Challenges



Do You Recognize Photos Like These?

FOG and Non-Dispersibles Challenges



Background Information

Recent News Quotes:

- *“COVID-19: Utilities have seen up to a 300% increase in loading of non-dispersibles” ...*
 - *U.S. EPA Report*
- *“Due to COVID-19, sewer backups are up 50%, attributed to the flushing of ‘wipes’”.*
 - *Larry Hare, P.E. – City of Des Moines, IA*
- *“... estimates flushing non-dispersibles costs \$1Bn/year in U.S.”*
 - *American Public Works Assn. (APWA)*
- *“We spend 18M pounds (\$25M USD) annually clearing 75,000 blockages and daily removing 30 tons of non-dispersibles”.*
 - *Thames Water Co. (U.K.)*

Effects of COVID-19 On Collection Systems

Loadings sky-rocket



One day after stay-at-home orders were issued...

The next alternative to be exhausted...



Effects of COVID-19 On Collection Systems

Home disinfection of the unseen virus...



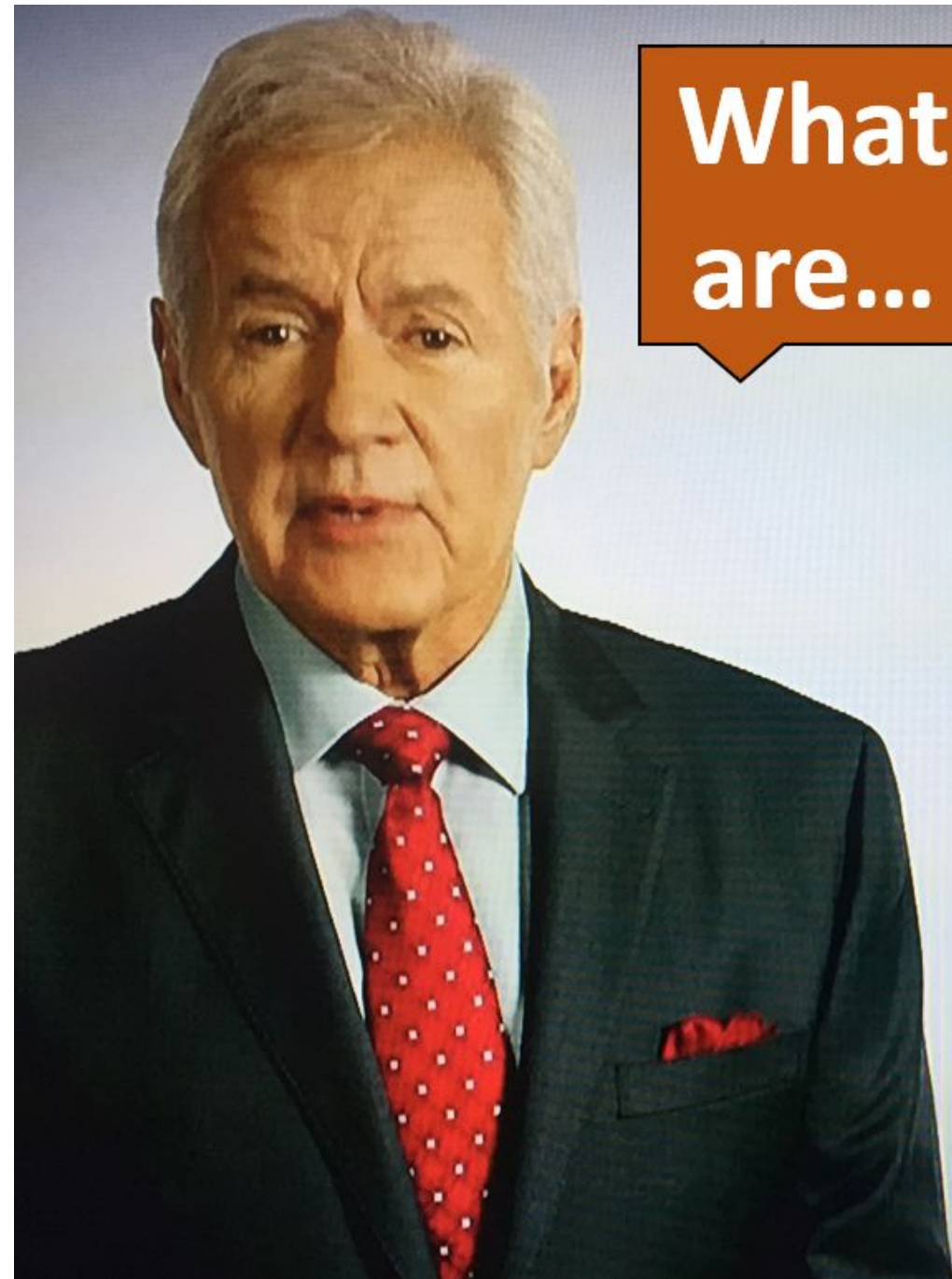
- COVID-19 significantly increased home disinfection
- Toilets provide immediate removal from the home
- Collection system non-dispersible loading skyrockets
- *Moving forward, is this the new “norm”?*



Wastewater Jeopardy!...

Items collection systems are designed to handle...

- Toilet paper
- Flushable wipes
- Poop
- Paper hand towels
- Facial tissue
- Dental floss
- Toilet wand pads
- Pee
- Feminine hygiene items
- Cleaning wipes



What
are...

P

EE

P

OOP

P

APER

Modern Collection System Headaches



Modern Collection System Headaches



Modern Collection System Headaches



Modern Collection System Headaches



Growth of Non-woven Goods Products

- Personal Care / Specialized Wipes Category
- \$2.8Bn (2017) > \$4.1Bn (2022)
- Highest net margin segment
 - Personal Cooling Wipes
 - Make-up Removal Wipes
 - Bug repellent wipes
- 3-4 New products launched monthly



Flushability - Modern Trash

Manufacturers quest to become unrecognizable...



Toilet paper
Brand
(~1-min)



Baby wipes
(24-hours+)



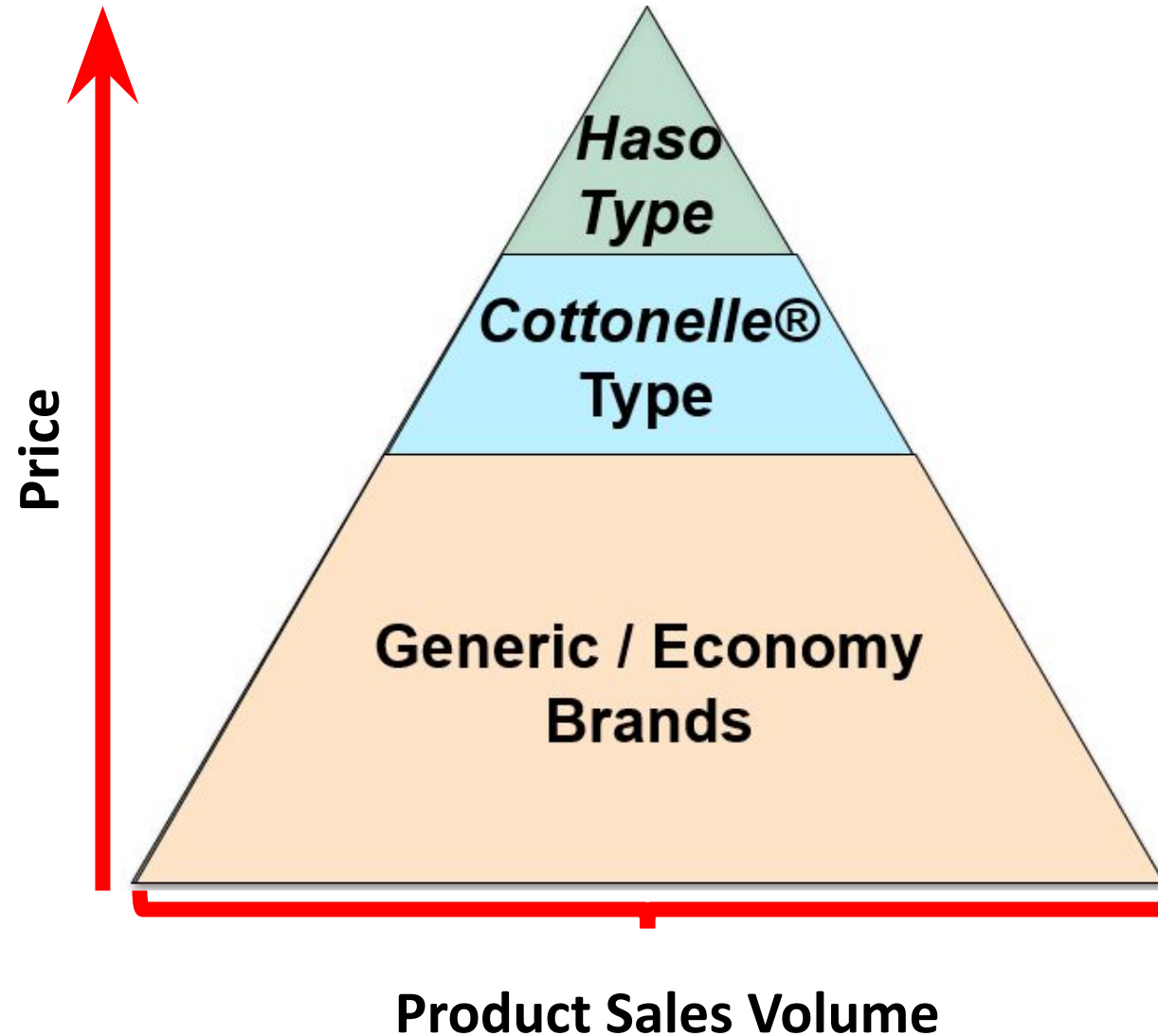
Hydraspun[™]
(30-min to 60-min)



Haso
(< 1-min)

Price - Product Pyramid

Non-woven type products



Now The Grease Cycle...



Deep Fryer



Neglected Grease Trap



Choked Pump Station



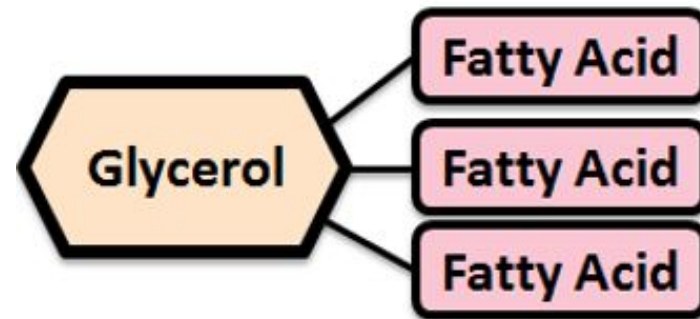
Clogged Pipes



Sanitary Sewer Overflow

What Is FOG?

- Fats, oils and grease (FOG) are compounds of one, two or three fatty acids combined with one glycerol ‘backbone’

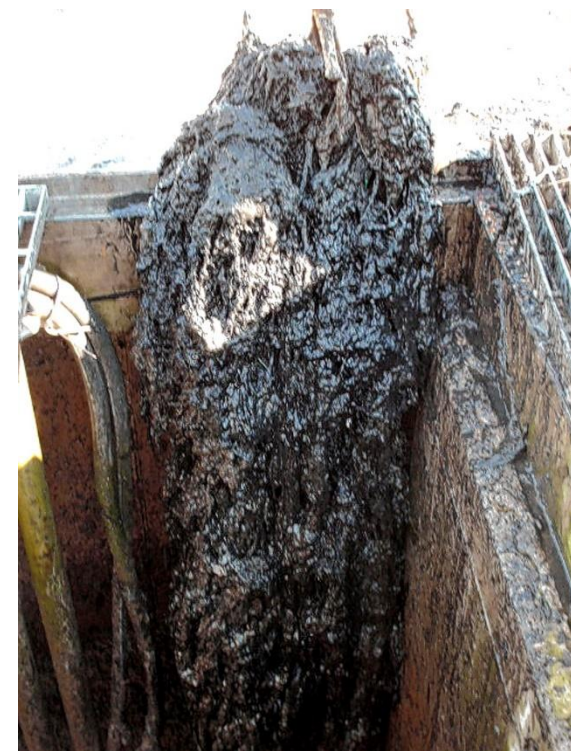


- FOG is derived from many industrial and food processes as well as a residue of domestic cooking
- FOG is “*Hydrophobic*”, grease molecules are highly stable and hard to break down

Treatment and disposal are very difficult

Non-dispersibles and FOG...

- Non-dispersibles are wonderful filtration products...
- They filter:
 - Grit**
 - Fats / Oils / Grease**
 - Biological material**
 - Sand**
- Greatly increases surface tension of the non-dispersible
- Materials easily combine, build into large masses



Fats, Oils and Grease Facts

- U.S. Municipalities spend \$25Bn annually to clean pipes
- Saponification occurs in sewer grease when calcium is around...
 - Think Concrete: Pipes, Manholes, Mortar, Pump Stations
- Collection system solidified grease chokes pumps and pipes
- 75% of U.S. sewers are fouled --- working at 50% capacity
- In L.A., a 5-year period of 2,000 overflows, 41% due to FOG
- NYC-DEP experiences, ~5,000 back-ups per year due to FOG

NYC-DEP Wastewater Treatment

Non-dispersible problems

- NYCDEP has spent \$18M over past 6 years removing non-dispersibles
- NYCDEP removes 110,000 yd³/mo. from WWTPs
 - Waste volume doubled in previous 5-year period
 - Estimates: 55,000 yd³ / mo. are non-dispersibles
 - Post-COVID-19 estimates: 140,000yd³ / mo. are non-dispersibles
 - Now Require 7,000 / 5-axle dump trucks / mo., each hauling 20yd³

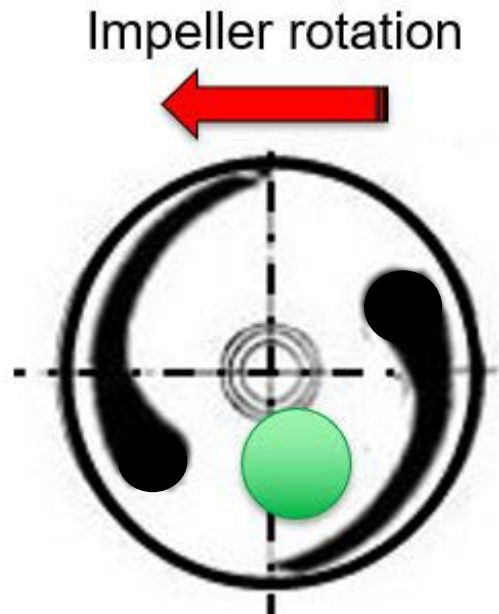


Pumping Perspective

Solids-handling Pumps – A historical perspective

Mr. A. Baldwin Wood – 1915

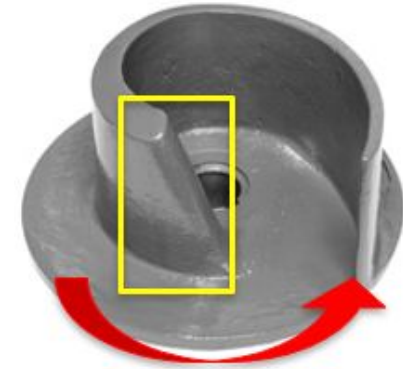
- Assistant Supt., New Orleans Sewer & Water Board
- “Father of the ‘non-clog’ wastewater pump”
- Developed the “Wood Trash Pump” design



Wood 2-channel solids-handling impeller... Large throughlets, Blunt vertical vane leading edges

Current Non-clog Type - Various Manufactures

All descendants of the “Wood Trash Pump” design

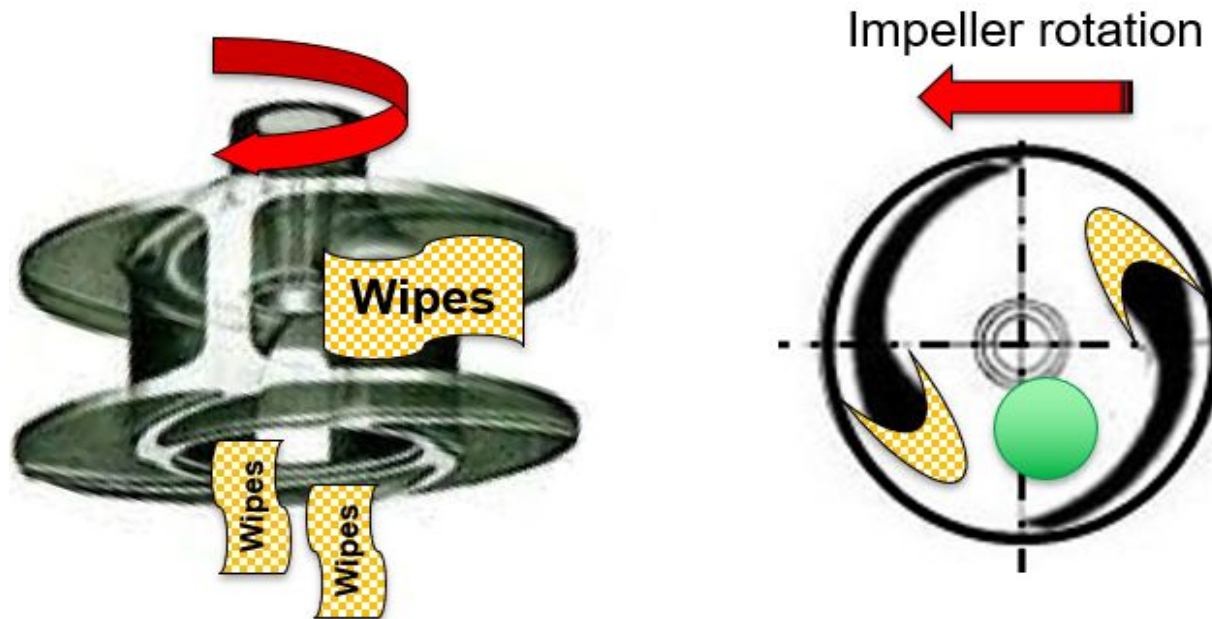


Common design elements: Minimum 3-in impeller port throughlet
Vertical vane leading edge position
Blunt vane leading edge, where possible

Solids-handling Pumps – A historical perspective

Mr. A. Baldwin Wood – 1915

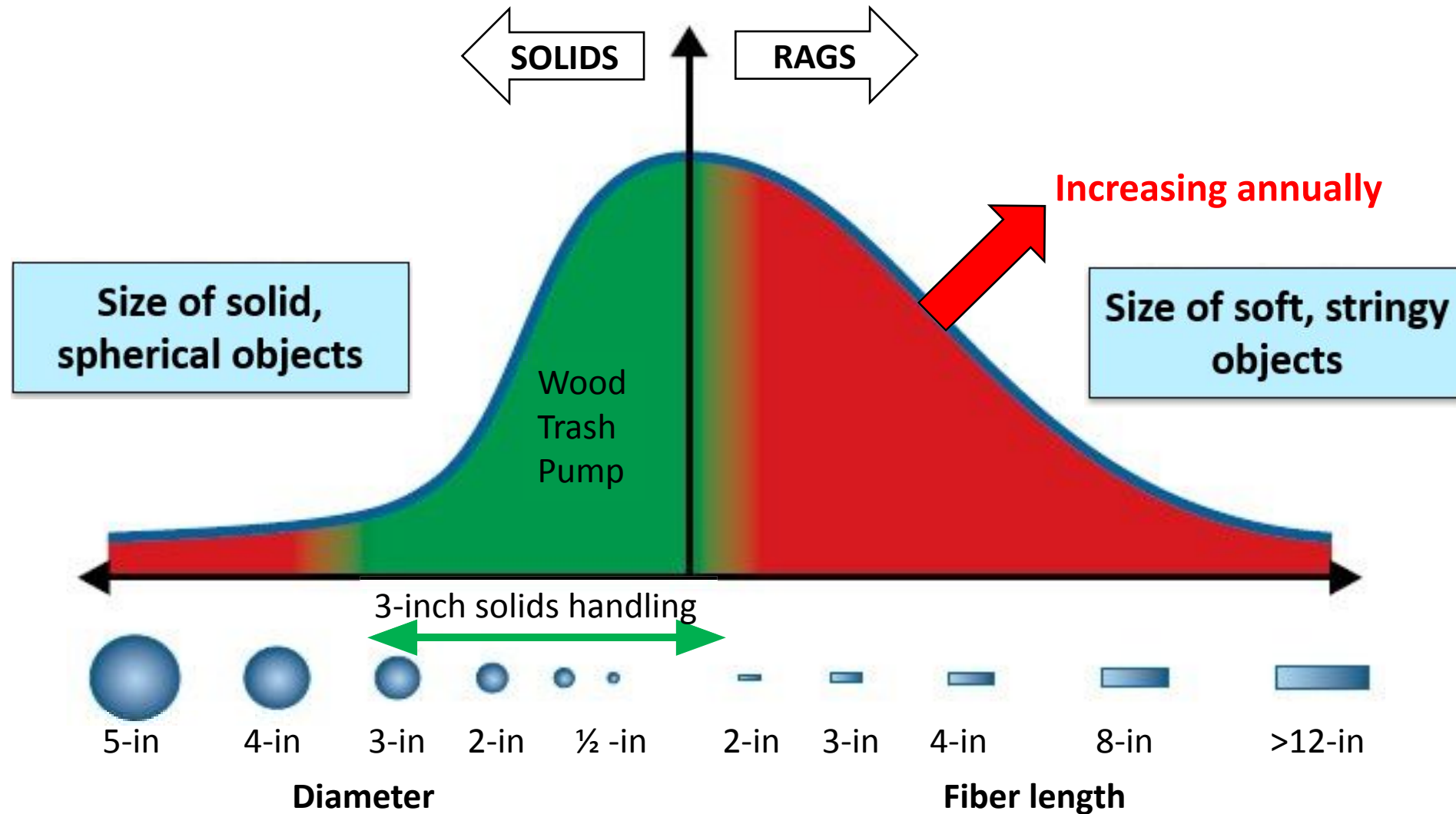
- Assistant Supt., New Orleans Sewer & Water Board
- “Father of the ‘non-clog’ wastewater pump”
- Developed the “Wood Trash Pump” design



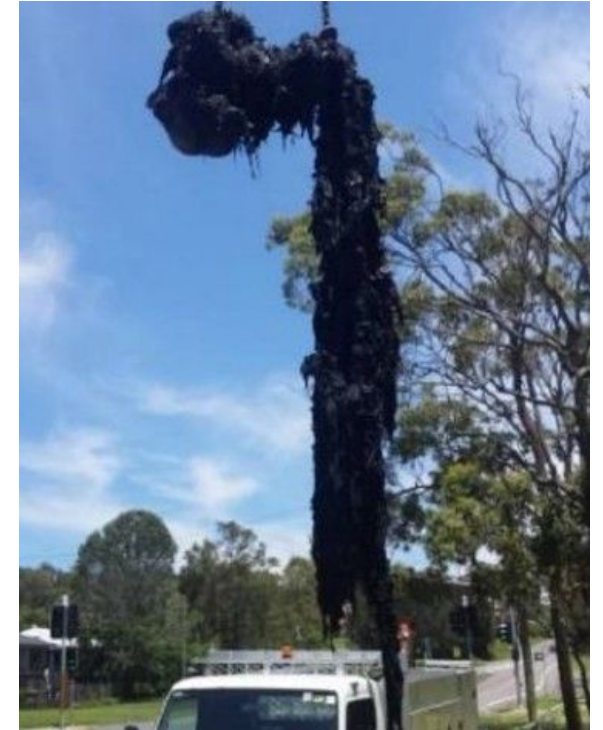
Typical 2-channel solids-handling impeller... Large throughlets, Blunt vertical vane leading edges

Studies Show Today's Reality:

Probability of solids and fibers distribution / passage



“Modern Tash”- Traditional “Wood” Non-Clog Pumps



Professional Clog Test Rig

Standardized pump clog test procedure



Laboratory Impeller Clog Testing

Solids-handling pump impeller types tested:



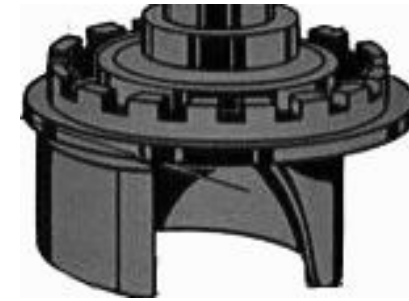
Closed 1-V



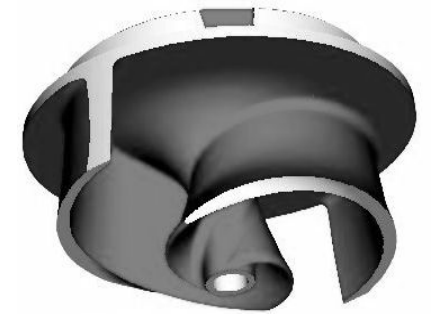
Vortex



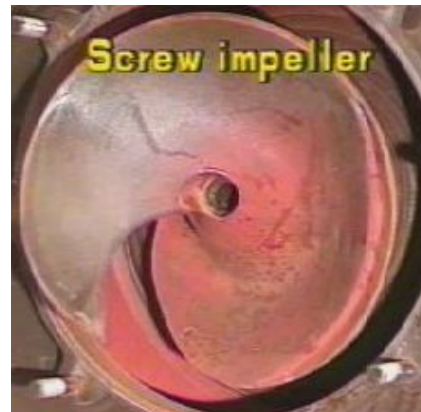
Screw



Semi-open 1-V

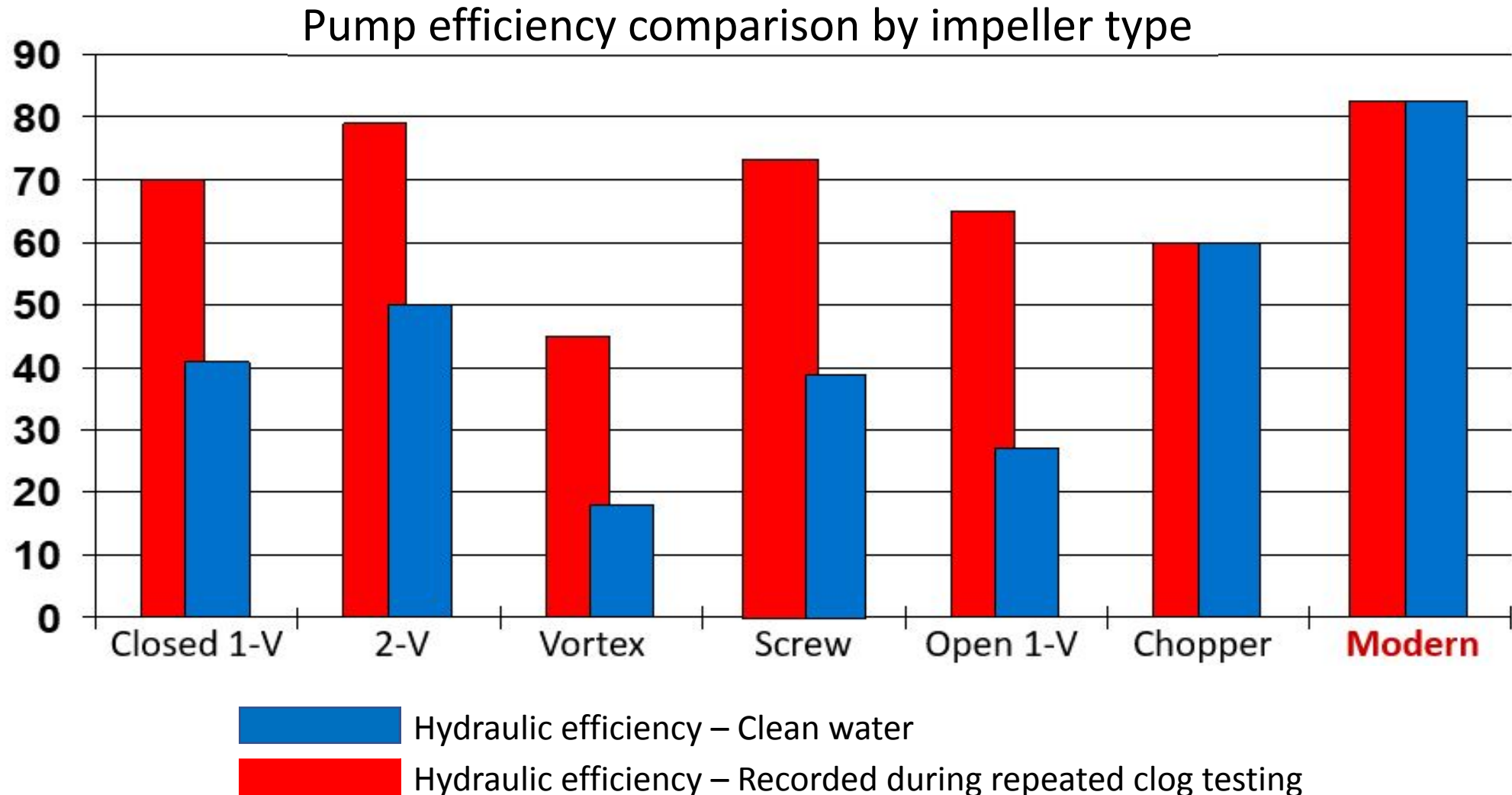


**Modern
Technology**



Hydraulics - Innovative Technology

In solids-handling pump design



Current Descendants of the “Wood Trash Pump”

2-channel impeller with blunt vertical leading edges



Reduced hydraulic efficiency



Mechanical failures

Larger Pump Impeller Throughlets: They are not the answer to Modern Trash!

(3) 16-in. dia. pumps are equipped with 'Wood' descendant impellers having
2 x 4.5-in. dia. throughlets... each clog regularly!



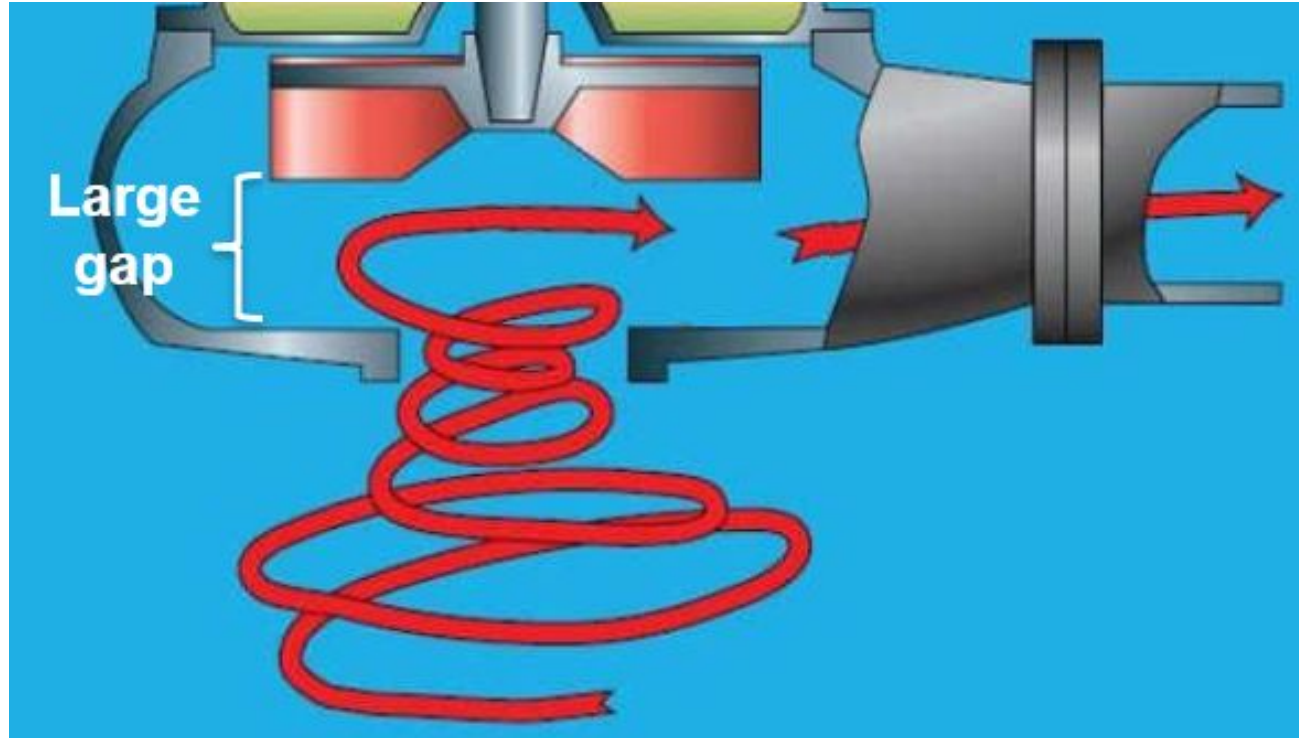
Innovative Technology

In solids-handling pump design

Clog test conclusions

1. To prevent clogging, impeller design is much more important than throughlet size.
2. Impeller vane leading edge angle is very important
3. The maintaining of cleanliness of the leading edge of the impeller vane(s) is of utmost importance.

Recessed Impeller Pump (i.e., Vortex, Torque-Flow)



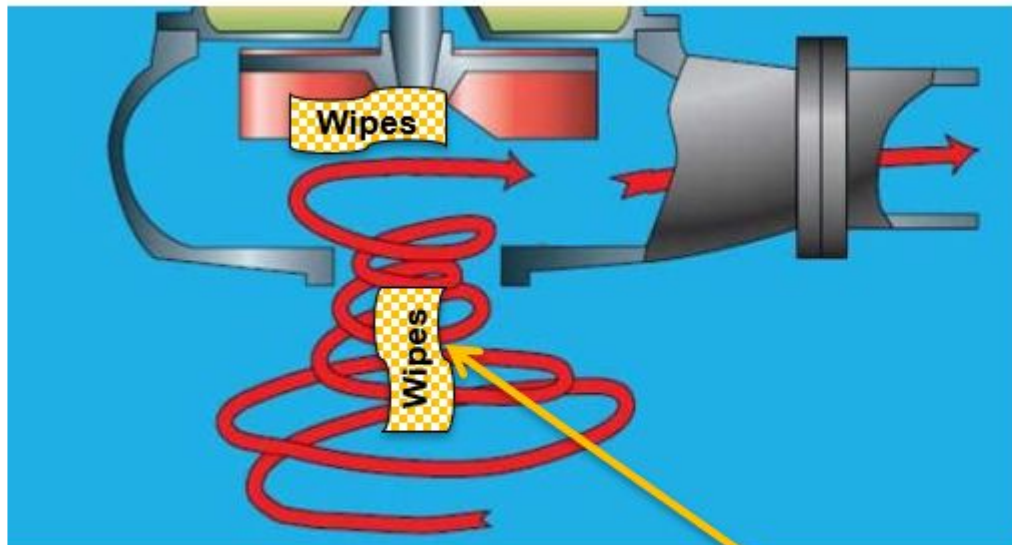
Recessed impeller type pumps operate by

- **Creates a tornado-like vortex rotation within the pump housing**
- **It extends downward under the suction inlet of the pump housing into the sump**

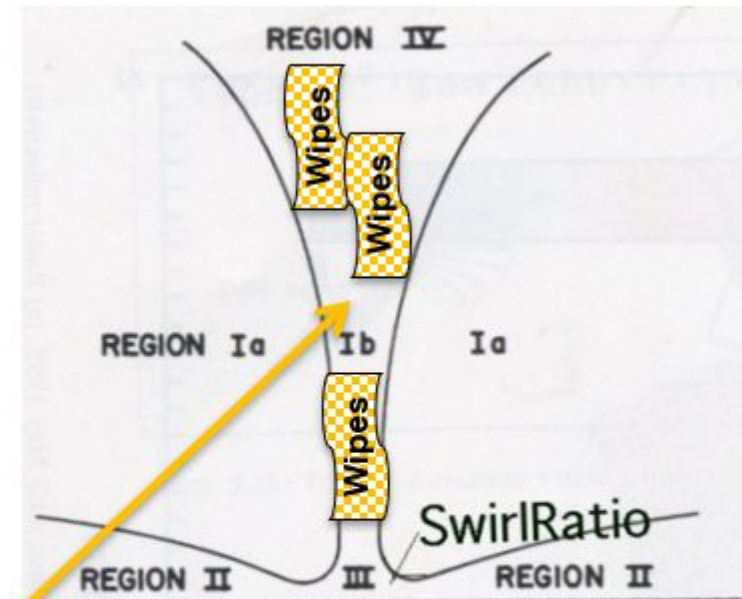
Tornadic Action

Low pressure in vortex center core

- Non-dispersibles travel up the low-pressure center core of the vortex, impinging upon the impeller bolt area of recessed impeller...
- This partially or fully covers the impeller vanes in a short time



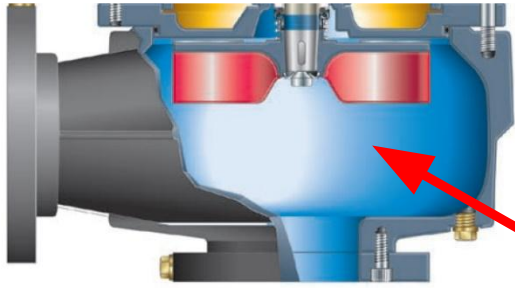
Vortex Pump



A Tornado

Region I b. Low-pressure center core

1940's Recessed Impeller Design



- Has very low clean-water hydraulic efficiency
- Large gap between the impeller and the bottom of the pump housing = **large hydraulic losses.**
- Non-dispersible materials travel up in the low-pressure center core to blind the impeller
- As expected, QH performance tests show that these issues are shared by all vortex type pumps.

Maximum overall test efficiency was 27.7 %.

Specifying A New Sewage Pump w/ 1910's to 1950's pump technology is like...



***The Massachusetts State Police ordering the latest Police Interceptor
Vehicles and specifying:***



1940's Bias-belted Balloon tires

Instead of:

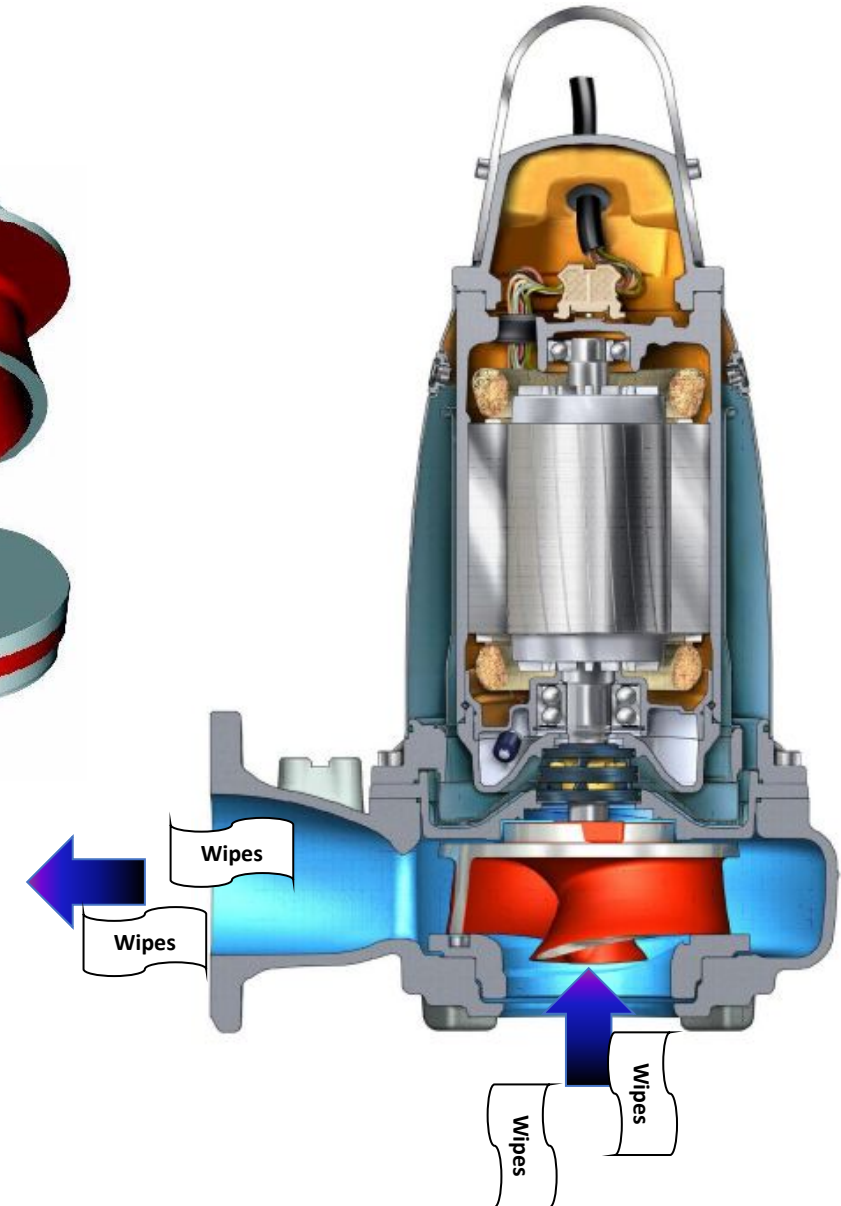
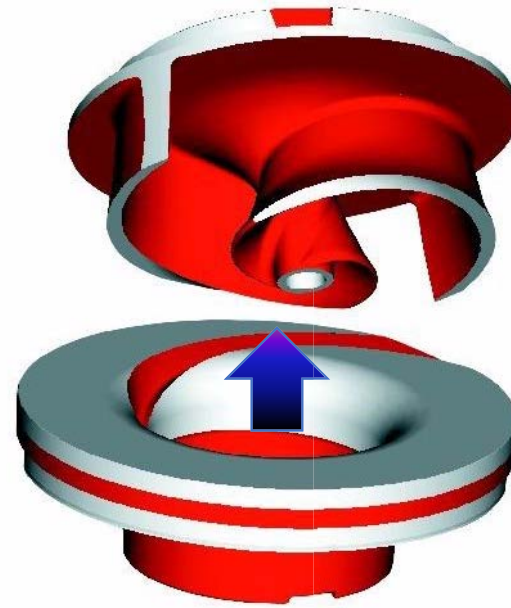


2022's Bridgestone Pursuit Radials

Modern Technology Pump Hydraulics



Self-cleaning hydraulics providing sustained high hydraulic efficiency

- Vane leading edge screw start
- Horizontal vane leading edge
- Vane edges are wiped clean at the interface of the relief-groove during each rotation



“Flushable” wipes causing problems for Thiensville sewer system

Posted on: 9:05 pm, January 15, 2013, by Jenna Sachs

 Recommend  8  8  Pinterest  0  Share  11  Twitter  3  Email

“While public education is important, ultimately we need to invest in improved, modern equipment that can handle this material”

Public Works Director – Andy LaFond



THIENSVILLE (WITI) — Cleaning wipes and towels advertised as “flushable” have been causing problems in Thiensville! If it weren’t for workers removing these “flushable” items from the Thiensville sewer system on a daily basis, the system could be in danger of failing.

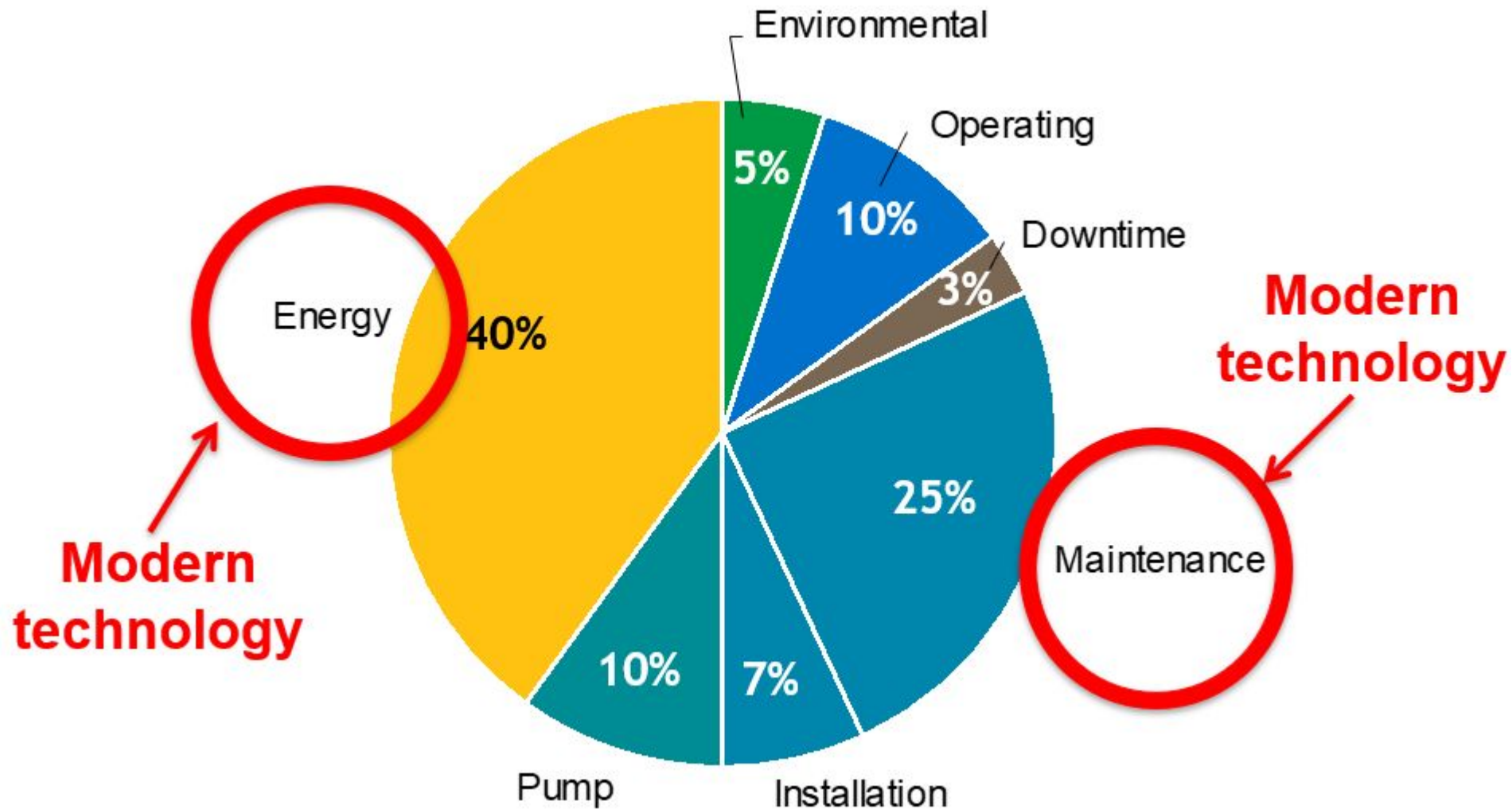
The Director of Public Works Andy LaFond says the blame lies with convenience products, often labeled as “flushable” — including disinfecting wipes, mop refills, toss-in toilet bowl wands and baby wipes.



CAPEX and OPEX Savings

Energy savings:

Life cycle cost for a pumping system (Source: EPA)



CAPEX - Energy Saving Project: City of Andalusia, AL

U.S. DOE Block Grant – Dept. of Economic Affairs

Project spec.: 25% energy savings required of the contractor

Riverside WWTP

- (3) 45-hp modern technology pumps
- **48.1%** Engineer-recorded svgs.



Central Lift Station

- (3) 85-hp modern technology pumps
- (2) 45-hp modern technology pumps
- **56.1%** Engineer-recorded svgs.



Opex Success Story: Borough of Fairlawn, NJ

2-Decades of Clog-free operation!



P.W. Supervisor: Mr. Jacob Mamo

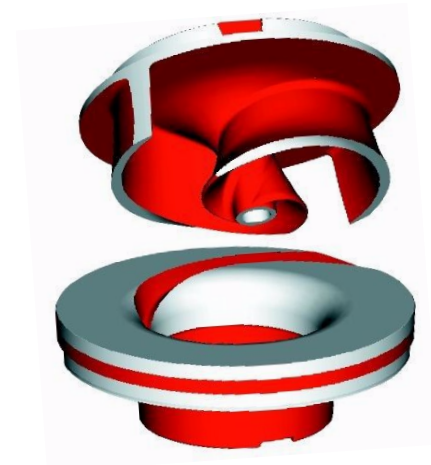
- **Radburn Sewage P.S. (Retrofit in 1999)**
 - 3 x 35-hp Dry-pit submersible pumps
- **Saddle River Sewage P.S. (Retrofit - 2001)**
 - 1 x 130-hp Dry-pit submersible pump
 - 2 x 75-hp Dry-pit submersible pumps

Clogging problems:

- (6) pumps clogged 1-2 times each day, 7-days per week = Min. 42 callouts/Wk.

Solution:

- Retrofit each pump with “Modern Technology” pump units
- “Modern Technology” pump units have not clogged since retrofit,
- >20-years CLOG-FREE operation!



Current Best Practices and Putting It All Together...

Current Best Practice

Pump-it, Grind-it, Screen-it

- **Pump-it**

- Proven innovative technology pumping solutions exist that capably handles *“Today’s Modern Trash”*

- **Grind-it**

- Reduce the mass of non-dispersibles wastewater solids
 - Can release micro-plastics into wastewater stream
 - Possible ground-apply sludge land ‘poisoning’ issues

- **Screen-it**

- Systems available to remove solids from within a lift station
 - May not be universally applicable
- Recommended size: 0.5” perforated screen

Putting It All Together

- **‘Modern trash’ / non-woven sheet goods / FOG are the No. 1 enemy of collection systems**
- **Conventional solids-handling pumps Wood Trash Pump / Vortex pumps are proven not to be able to handle ‘modern trash’**
- **Public education so far seems to have a limited benefit**
- **Strained budgets due to the need to repeat pump cleaning as the problem worsens each year**
- **Proven modern pump solutions exist that deliver sustained efficiency and greatly minimize maintenance**
- **Utilities need to select the Current Best Practice to suit needs and budgets**

Questions?...

Thank you and stay safe!