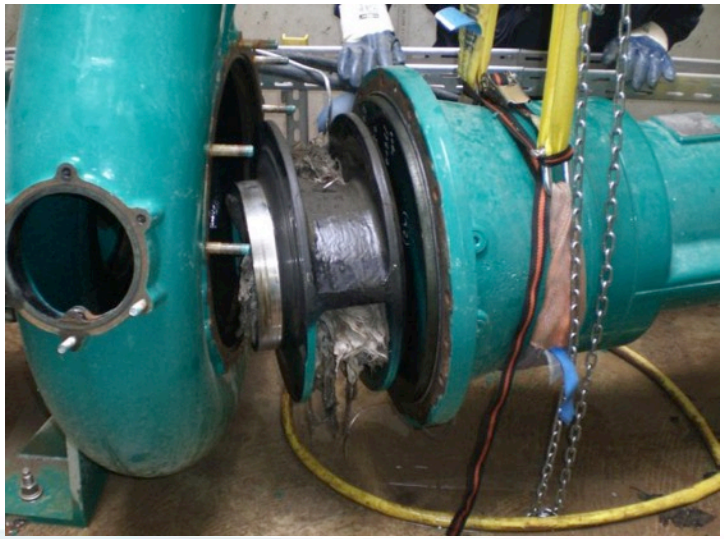
"Grind It, Pump It, Screen It… Update to the Current Status of Wipes Testing and Handling of Modern Trash"

Bob Domkowski
Engineering Consultant
Xylem, Inc. – Flygt Products

Do You Recognize Photos Like These?

Modern trash challenges



Flushable does not mean 'Flow-able'!

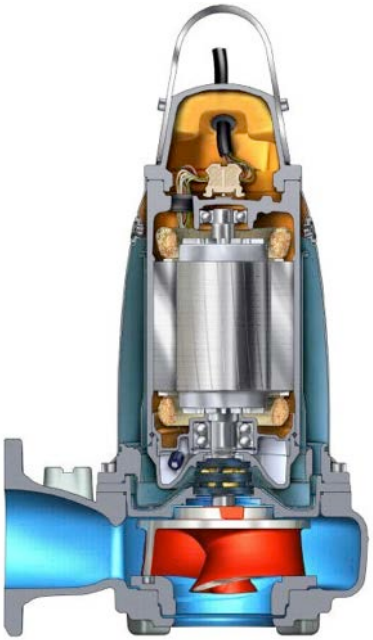
Collection System and Treatment

Modern trash challenges

Handling Modern Trash:
Current utility choices…

Grind it

Pump it



Screen it

Recent News Quotes:

- *"85% to 90% of all backups seen today are preventable and are caused by non-flushables"*
  - Jerry Ledbetter, Environmental Dept.. City of Claremore, OK
- *"We take out 2 to 3, 5-gallon buckets of wipes every week from each (sewage) pump station"*
  - Pete Jones, Ocean City, MD
- *"Wipes are clogging up sewers like nothing else sewer workers have ever seen!"*
  - Anne Heyden, San Antonio (TX) River Authority
- *"It's good news for me but bad news for the public"*
  - Scott Levin, Levin Pipe Cleaning Services

What To Flush Quiz…

What items is a collection system 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 To Flush Quiz…

What items is a collection system designed to handle?

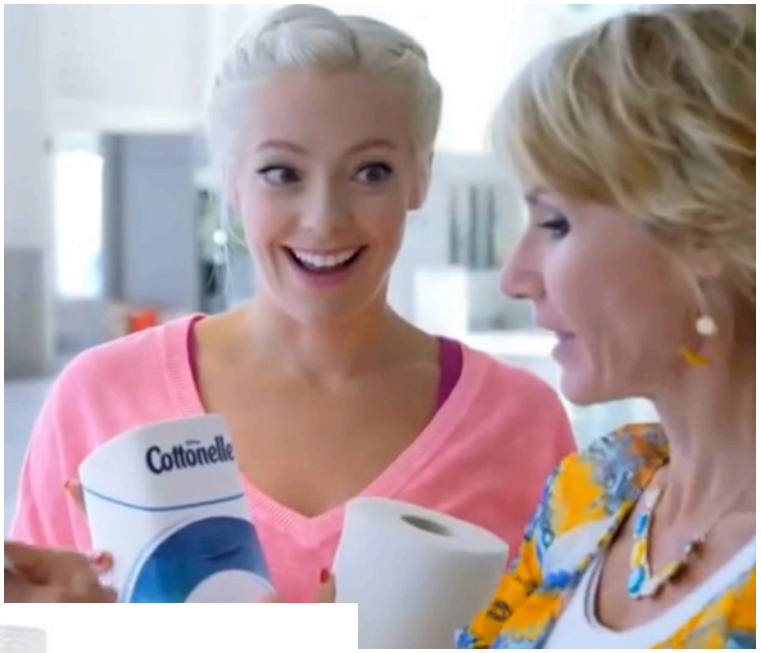
Only 3!

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

Modern Collection System Headaches

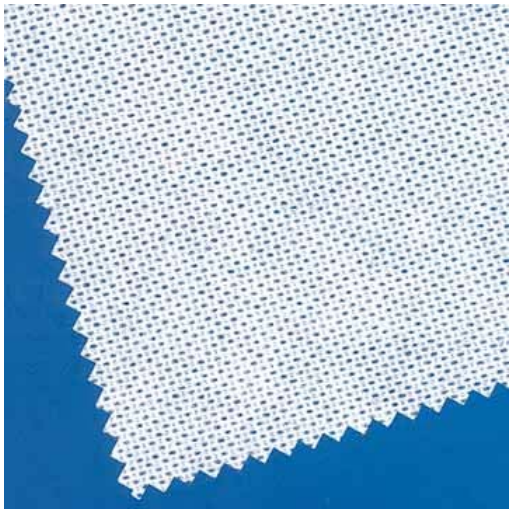
Wipes TV Advertising Campaign

Cross ad for dry and wet products



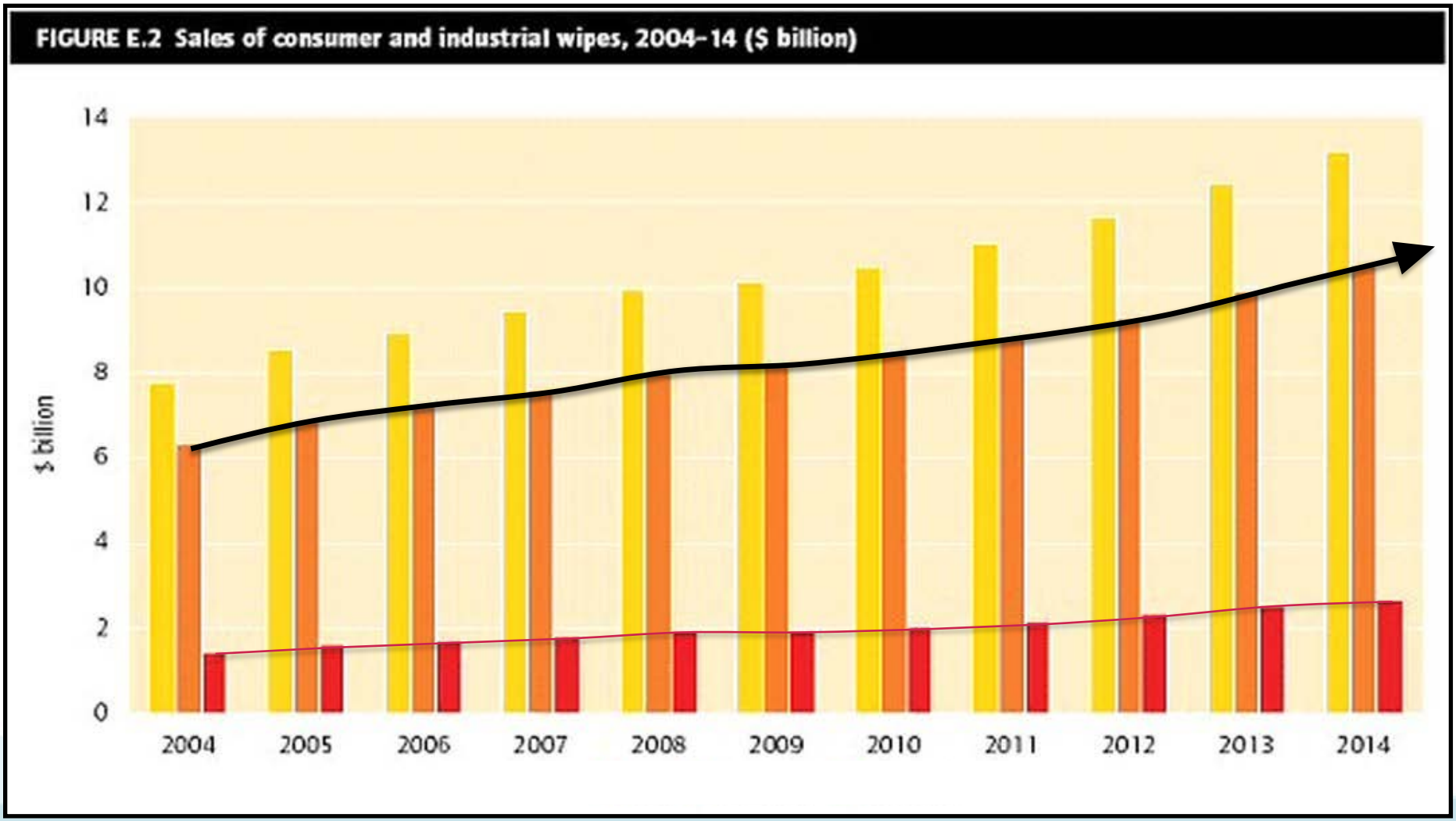
Typical "Modern Trash"
Non-woven sheet goods

- Typical manufacturing process:
  - Needle punch
  - Thermal bonding
  - Chemical bonding
  - Wet layup (New)
- Typical commercial products
  - Baby / personal wipes
  - *'Swiffer'* wiping sheets
  - Dryer sheets
  - Baby diaper liners
  - Toilet bowl cleaning pads
  - Personal care wipes
  - ***3-4 new products monthly!***



Wipes: 2004 – 2014 Market Sales

Industrial Wipes Consumer Wipes Total Wipes



Wipes – Continued Growth

Portability and convenience, coupled with the hygiene aspect of single usage, has popularized wipes among consumers

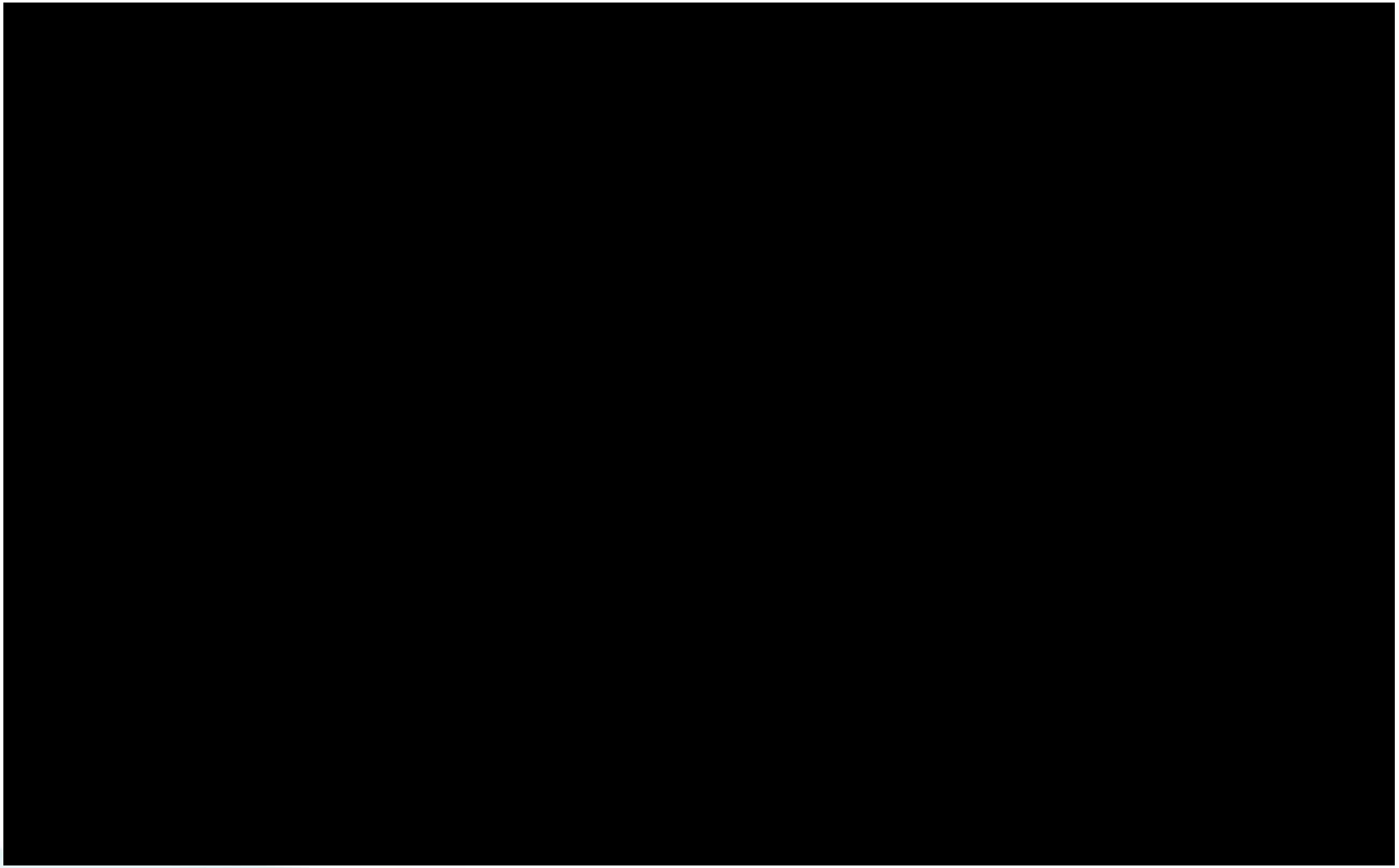
- **American market growth will be driven by:**
  - **Improved economy and higher disposable incomes.**
  - **Consumers recognize wipes are superfluous products**
  - **Perform same cleaning functions as liquids and rags**
  - **Wipes reduce supplies needed; purchased of convenience**
- **Large, established baby wipes category:**
  - **Driven by gains in the infant population**
  - **Further growth - consumers use wipes for personal use**
  - **Some reduction as consumers who used less expensive baby wipes for non-diaper applications during economic downturn return to task-specific wipes**

Wipes – Current Trends (Fredonia Report)

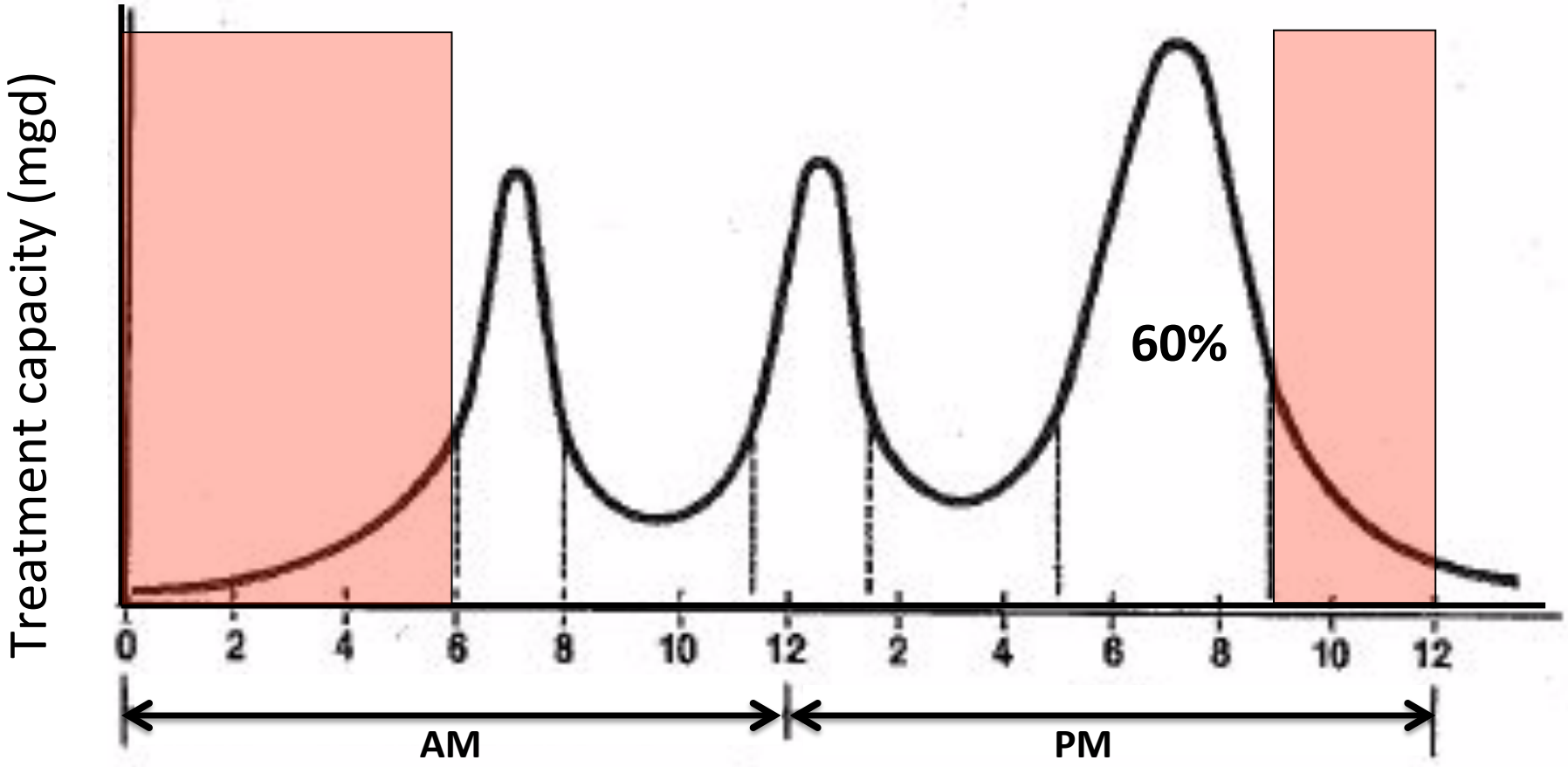
- **U.S. Wipes demands and sales forecast:**
  - Sales have increased by 5.1% per year through 2016
  - Will increase by 3.6% per year through 2018
  - Will increase to $2.8Bn sales
  - Largest segment gains:
    - Disinfectant wipes / Electrostatic wipes (Dust control)

- **Competitive landscape:**
  - P & G (28%)
    - Pads - Swiffer-brand floor cleaning
    - Paper - brand home care and baby wipes
  - J & J (27%)
    - Neutrogena-brand facial and make-up removal wipes

Kohler Ad: Toilet as a Trash Can…



Typical WWTP (Diurnal) Curve



Sewage flow duration pattern for a typical municipality

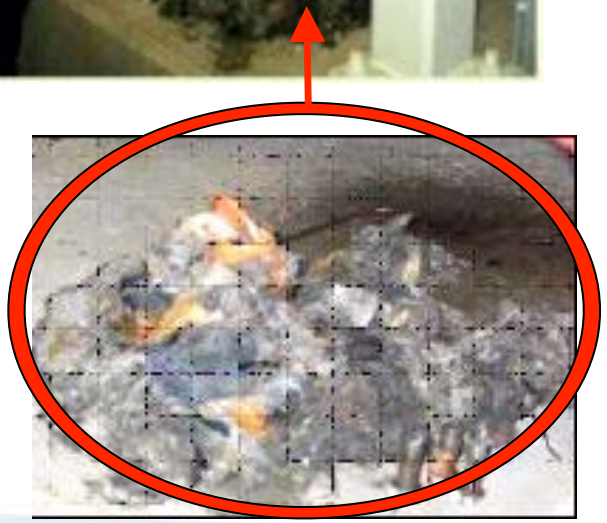
Portland Water District (PWD), Portland, ME

'Awareness campaign'

12-in
Pump

16-in
Suction line

PWD Spends $4.3M installing (2) Screens



KOIN-TV: Vancouver, WA
Collection System 'Flushable' Problems

Anderson P.S. - Vancouver, WA

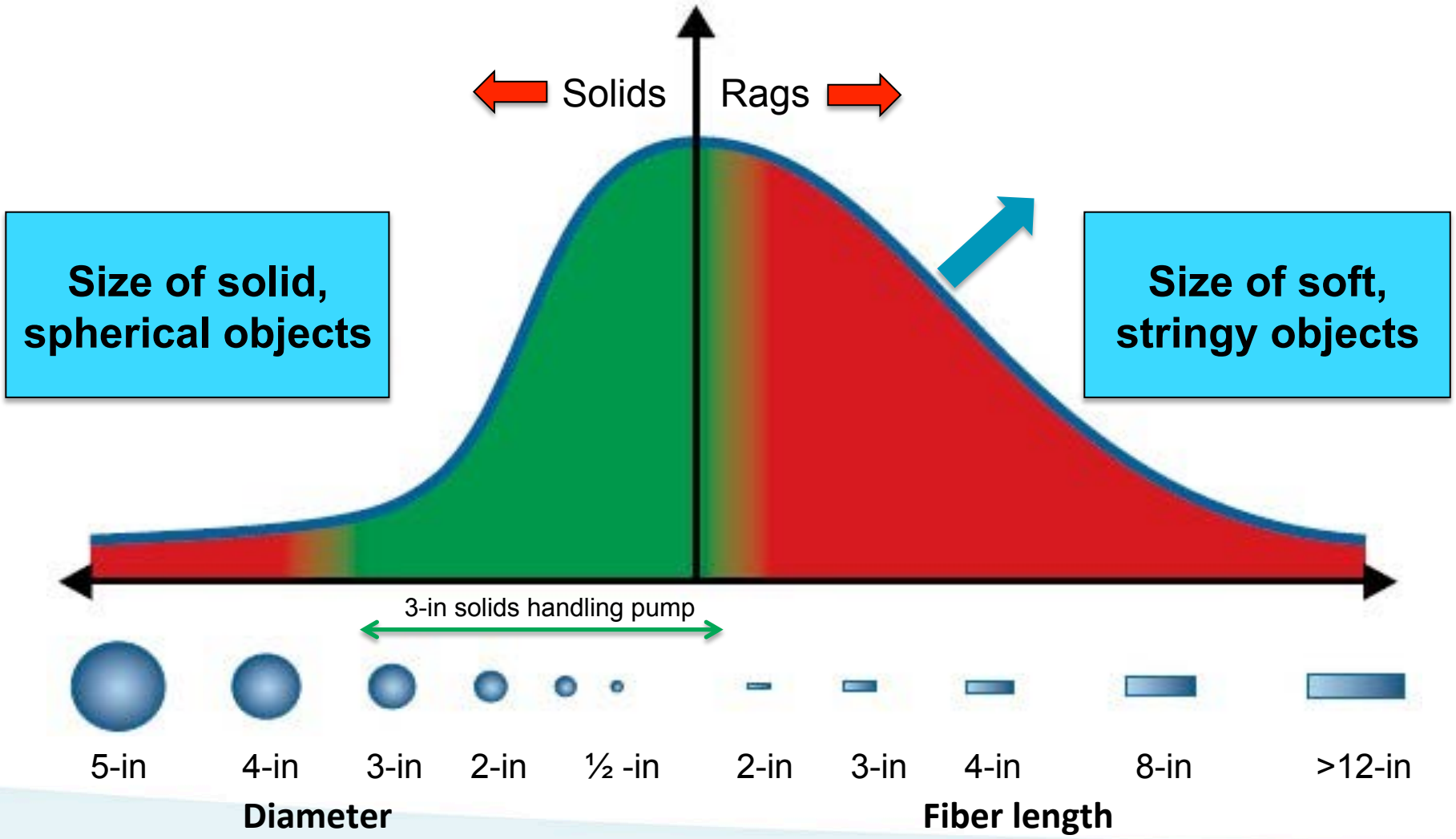
P.S. Modifications

Video capture

Current status

Studies Show Today's Reality:

Probability of solids and fibers distribution / passage



Complications of 'Modern Trash'
"Environment 1992 Conference"

"Flushability, Transportation and Decomposition of Non-woven Products"

Foretold challenges due to:

- **Reduced water component in wastewater**
  - **EPAct (1994) reduced toilet flush volume to 1.6 gallons**
  - **Low-flow shower heads**
  - **Now… Even 'waterless urinals'**
- **Explosive growth of flushable product sales**
  - **+10% market growth per year**
- **Laboratory and field studies predicted**
  - **Difficulties in developing wipes that met both:**
  - **Consumer demands**
  - **Possible regulation**

INDA: The Industry's Take on Wipes…

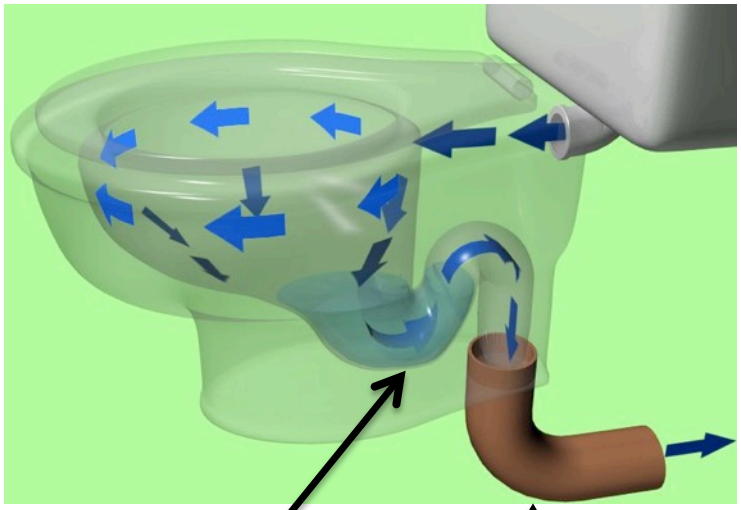
INDA - Flushability Project

Flushability Project… *What is flushable?*

- 'Flushability' has been left up to individual manufacturers
- High risk to systems:
  - Non-woven products harm both homeowners and municipalities
- INDA Develops standardized product test rig
  - Products can be compliance tested
- INDA external experts have developed a test program
- Flygt is one such *'external expert'* consultant to INDA
  - I am a consultant to Kimberly-Clark and Proctor & Gamble

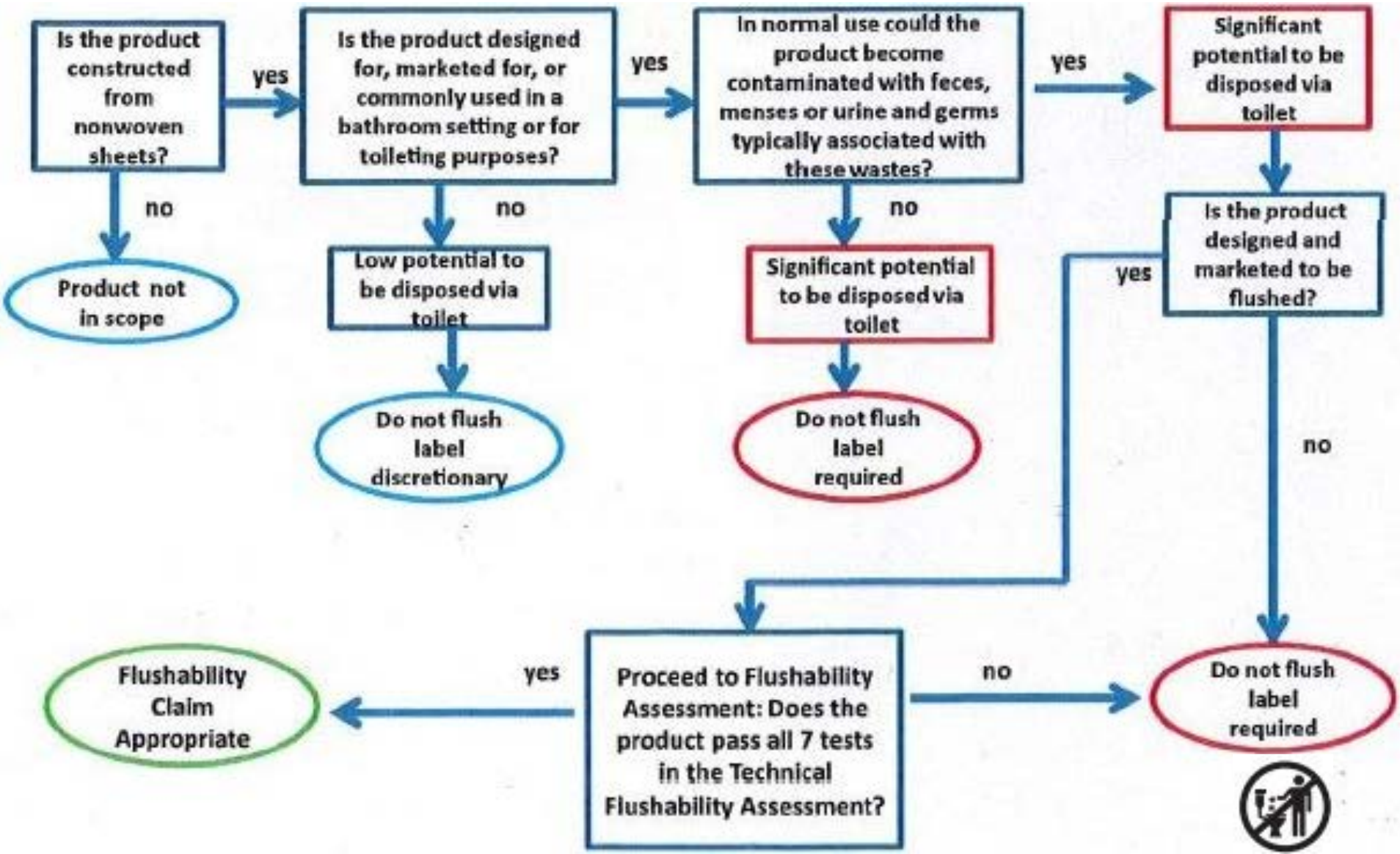
Original Flushability Test…

Will flushables make it through the ‘S’ bend?



Flushability Assessment Decision Tree

Product labeling to comply with Code of Practice



"Flushability" – Current INDA Definition:

Definition of Flushability

For a product to be flushable it must:

- Clear toilets and properly maintained drainage pipe systems under expected product usage conditions;
- Be compatible with existing wastewater conveyance, treatment, reuse and disposal systems; and
- Become unrecognizable in a reasonable period of time and be safe in the natural receiving environments.

Note:
Flygt 3085 3-hp submersible pump is the basis of INDA standardized flushability test for product certification

Flushability - Modern Trash
Quest to become unrecognizable…

Toilet paper
(1-min)

Current wipes
(24-hours)

Hydraspun™ substrate
(20 min to1-hour)

Today's reality: MWWCA Membership

A Recent Collection System Operations Survey

87.5% experienced problems with "flushable' products.

61.4% experienced >10 incidents with "flushable" items

84.4% clogging problems in small lift stations due to "flushables"

51.1% clogging problems in large lift stations due to "flushables"

59.6% Costs due to 'flushables' is up to $1,000 per incident

12.8% Costs due to 'flushables' of up to $2,000 per incident

88.9% Report that problems with "flushables" are increasing

In 2011: <u>Average annual cost</u> for each Maine city = $37.5K

Collection System Headaches: 2013 Orange County (Ca.) Sanitary District

- **(2) WWTP with total capacity of 210MGD**
- **Collection system size: (2.3M people)**
  - **587 miles of conveying lines (OCSD)**
  - **4,513 miles of satellite lines (Others)**
  - **OCSD owns15 pumping stations**

- In 2011-2
  - Condu ns (971 / 15 = 65)
  - Spend
- Worst sin .
  - 10 em
  - (40) 3 s were re
    from t

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- Collection system size:
  - 587 miles of conveying lines (OCSD)
  - 4,513 miles of satellite lines (Others)
  - OCSD owns15 pumping stations
- **In 2012-2013 OCSD:**
  - **Conducted 971 corrective de-ragging actions**
  - **Spend $320,000 de-ragging pumps**
- **Worst single day recorded:**
  - **10 employees took 8-hours to clear 5 P.S.**
  - **(40) 35-gal contractor trash bags of debris were removed from the (20) pump units**

NYC DEP – Wastewater Treatment

Non-flushable problems

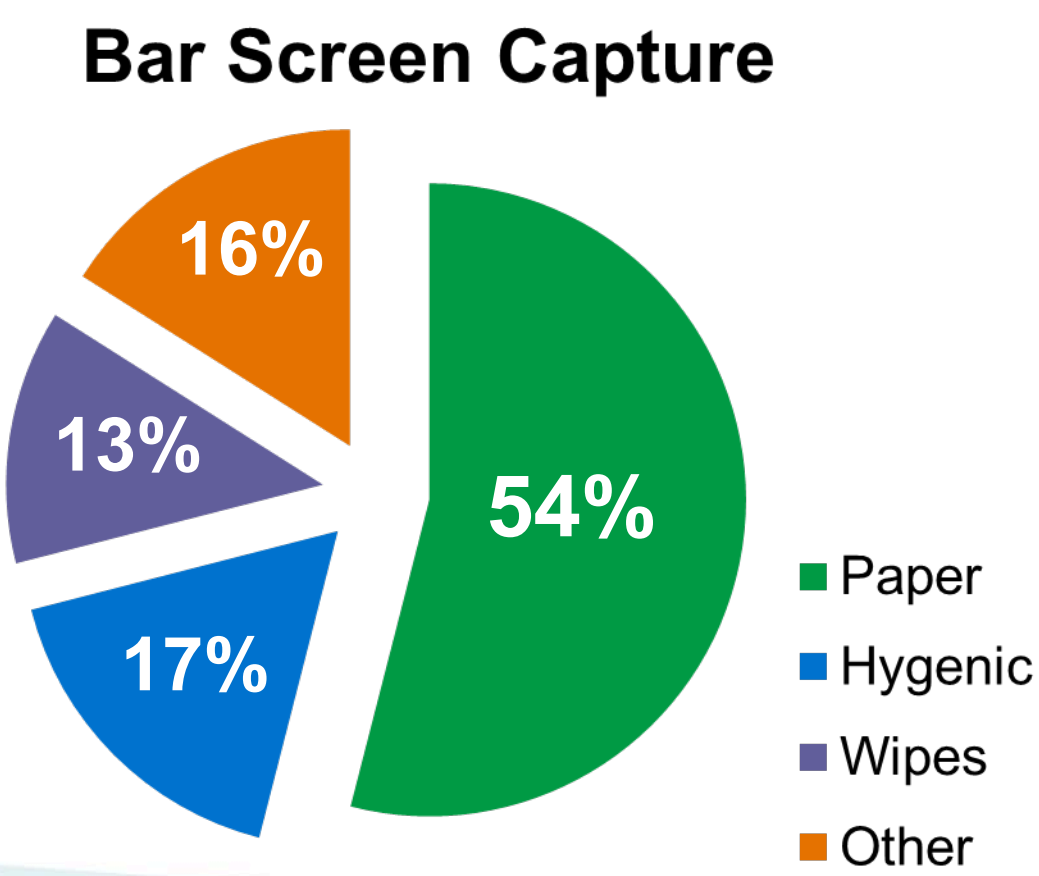
- **DEP has spent $18M over past 6 years manually removing wipes from their collection system**
- **DEP carts away 110,000 yd^3/mo. from WWTPs**
  - **Waste volume has doubled in past 5 years**

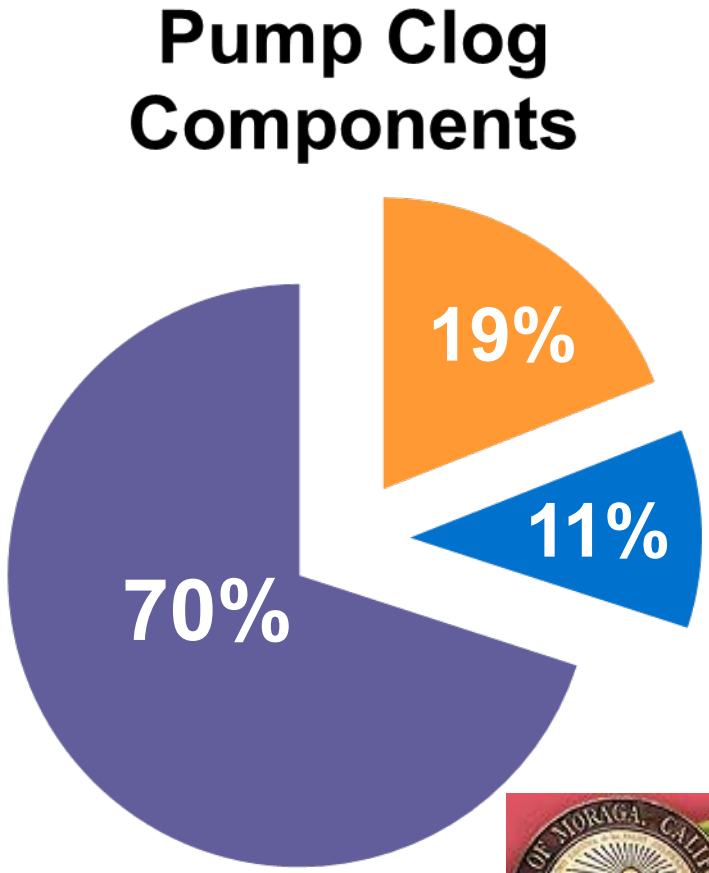
INDA Case Study:
Town of Moraga, Costa County, CA

- **Significant number of pump clog incidents per month**
- **3” bar screen replaced with 1.5” bar screen**
- **Case study results:**
  - **Increased frequency of bar screen cleaning**
  - **Bar screen blinding by ‘pan-caking’ of brown towel sheets**
  - **While reduced, 6-in pumps each still clogged 3-4 times /mo.**

Town of Moraga, Costa County, CA

Recorded wastewater trash distribution





Case Study:
Town of Moraga, Costa County, CA

Pump clogs mainly consisted of:

- Long, twisted, knotted formations
- Strong non-woven materials
- Long fibrous products:
  - Personal hygiene products
  - Household cleaning wipes
  - Personal wipes

Town of Moraga, Costa County, CA

Typical pump clog sample

Washed pump clog debris

Decomposed debris clog

Modern Wastewater:
Wastewater pumping is a tough application!

Courtesy of Jacksonville Electric Auth.
(~1,200 Pump stations)

Courtesy of San Antonio River Auth.
(Collection system:189 mi.)

Modern Wastewater:

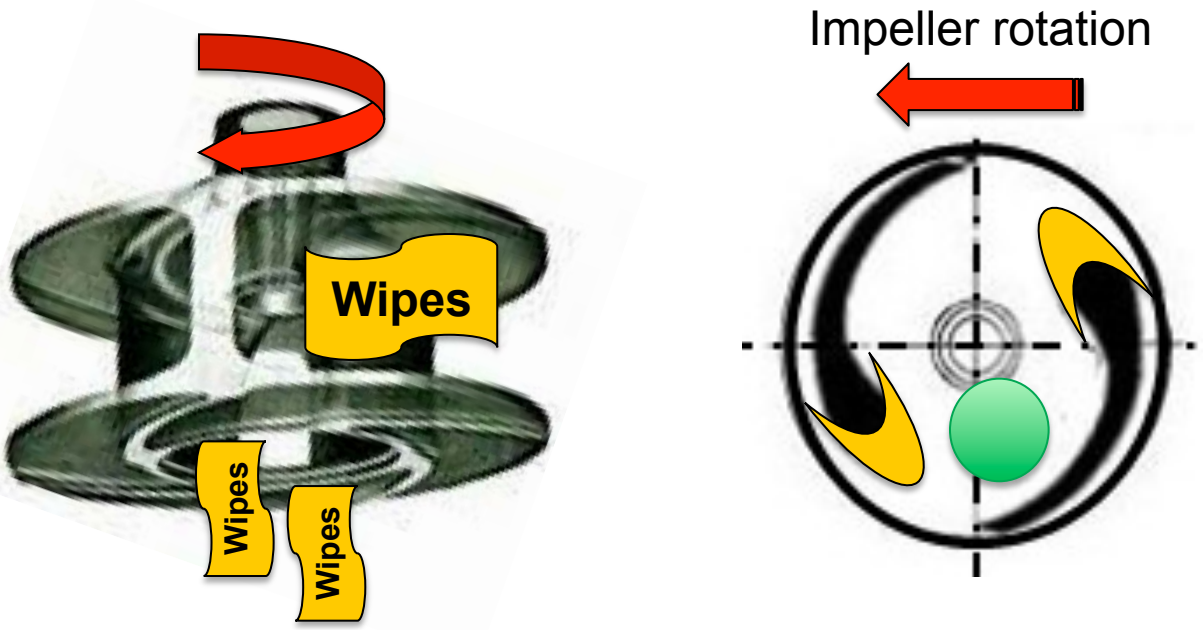
Today's wastewater pumping is a tough

Courtesy of City of Peoria, AZ
(24 Pump stations)

Solids-handling Pumps – An historical overview

Mr. A. Baldwin Wood – 1915

- Assistant Superintendent, New Orleans S & WB
- *"Father of the 'non-clog' wastewater pump"* developed the Wood "Trash Pump"



Typical 2-channel solids-handling impeller…
Large throughlets, **vertical** blunt vane leading edges

Descendants of the "Wood Trash Pump"
2-channel impeller with blunt leading edges

Reduced efficiency

Mechanical failures

The Answer Is Not Larger Impeller

Throughlets!

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

“Flushable” wipes causing problems for Thiensville sewer system

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

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.

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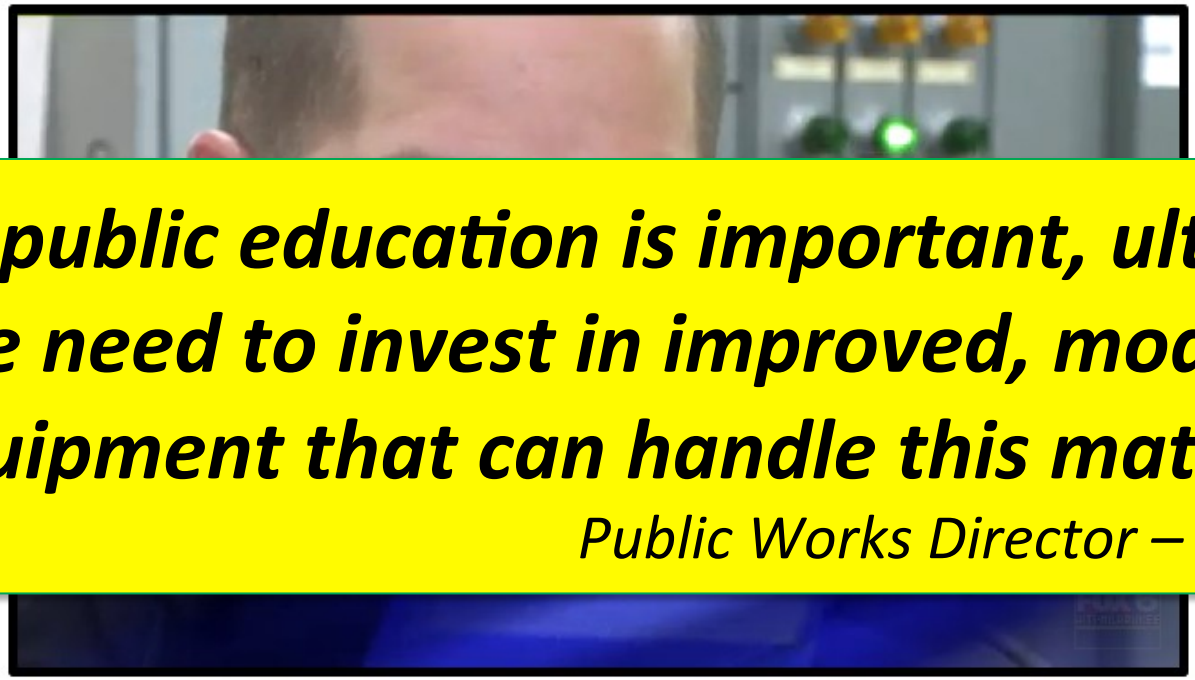
Recommend 8 8 Pinterest 0 Share 11 Twitter 3 Email



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

Public Works Director – Andy LaFond

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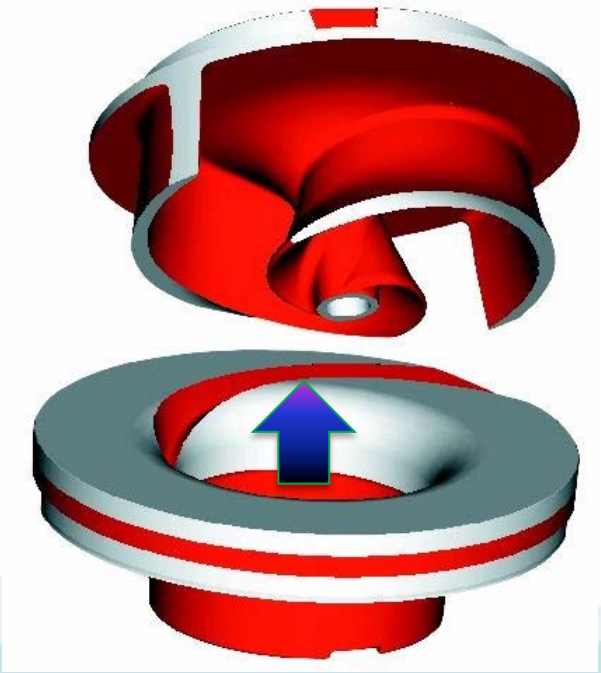
The Director of Public Works Andy LaFond says the blame lies with convenience products, often labeled as “flushable” — including disinfecting wipes, mop refills, toss-in toilet bowl wands and baby wipes.

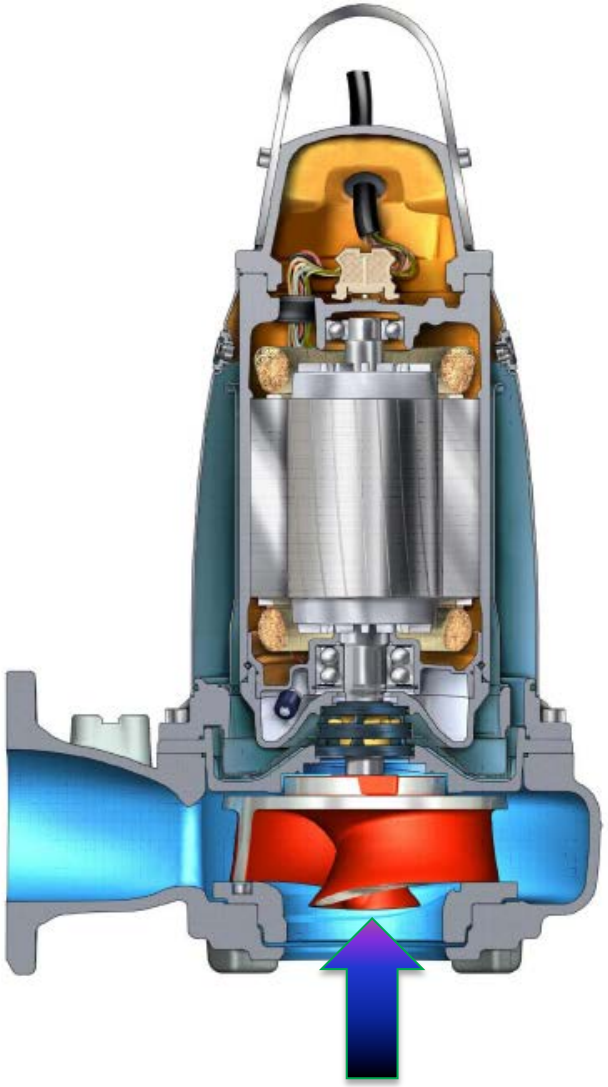
Innovative Technology

Self-cleaning hydraulics providing sustained high hydraulic efficiency

Horizontal vane leading edge

Vane edges are wiped clean at the interface of the relief-groove during each rotation





Innovative Technology

Laboratory tests and field installations show that sewage pump clogging is mainly due to:

1. Rags get stuck on the impeller vane edge or in the eye of the impeller

2. Jamming of the impeller / wear ring.

3. Full plugging of the volute (Vortex pumps)

Recessed Impeller Pumps –
Not the answer…

- Poor hydraulic efficiency = Larger motor
- Vortex caries trash up to impeller hub
- Easily clog with ‘modern trash’
  - Volute can totally pack with trash
- May need to change switchgear:
  - Larger breaker
  - Increase incoming power service
  - Larger stand-by generator

Laboratory Impeller Clog Testing

Professional Clog-Test Rig

Laboratory Impeller Clog Testing
Laboratory test protocol

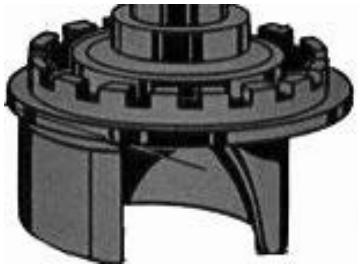
- **Test objects, 50 pieces of each:**
  - 10 mil plastic strips
  - '*Wettex*' dish cloths
  - Reinforced textile rags
- **The 8" to 10" square test objects were fed into each pump:**
  - One piece at a time, in 15 sec. intervals.
- **Tests were performed at flows of 900 gpm and 1,250 gpm:**
  - (7) type hydraulic designs were tested
  - (6) Pump manufacturers
  - All test program pumps were 4-in pumps

Laboratory Impeller Clog Testing

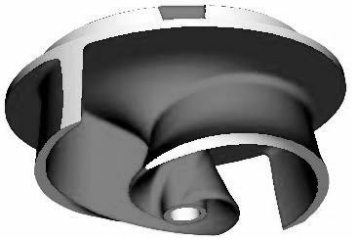
Closed 1-V

Vortex

Screw



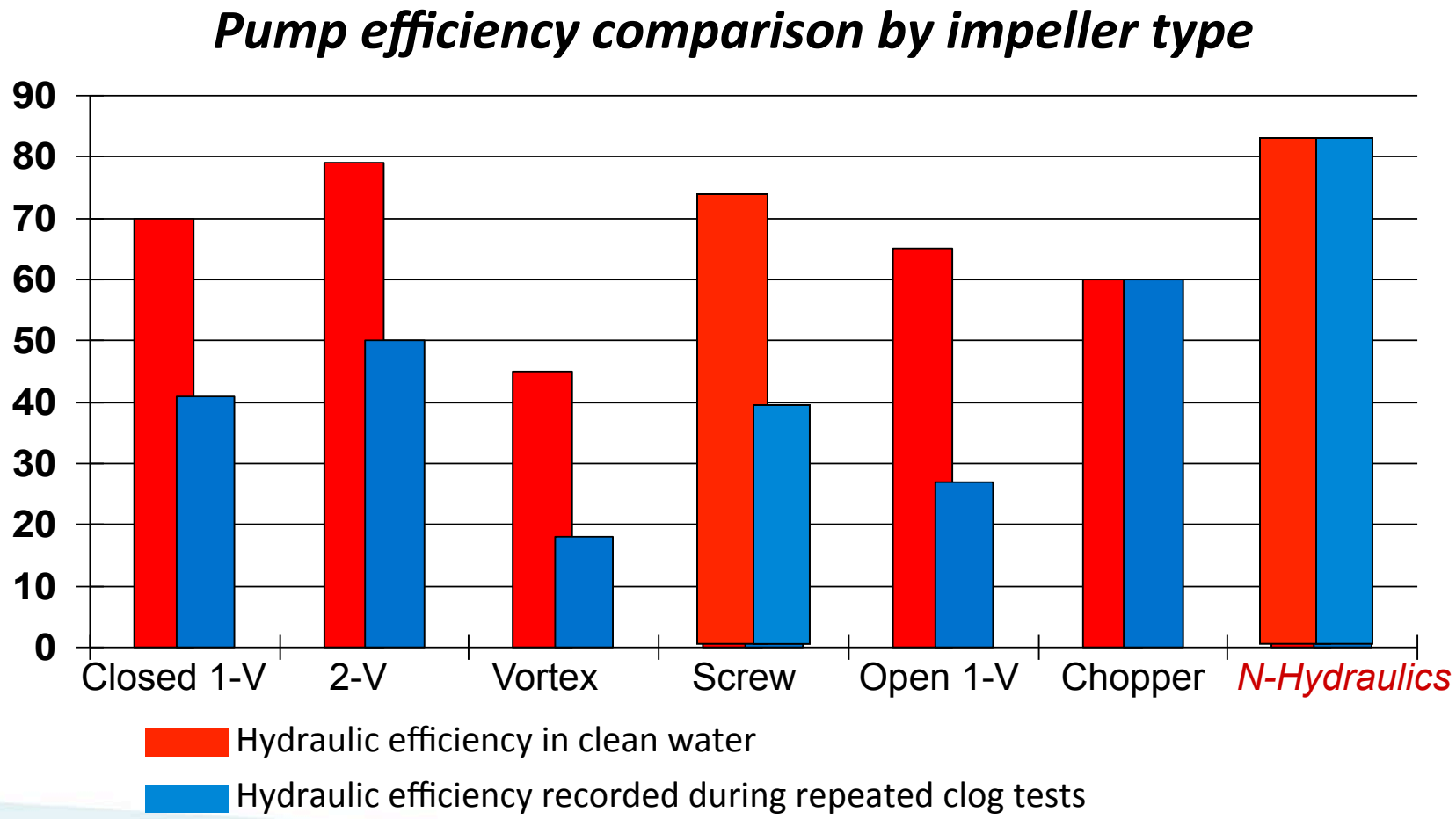
Semi-open 1-V



N-Technology

Laboratory Impeller Clog Testing

Test results



Laboratory Impeller Clog Testing

Test results

Clog test conclusions:

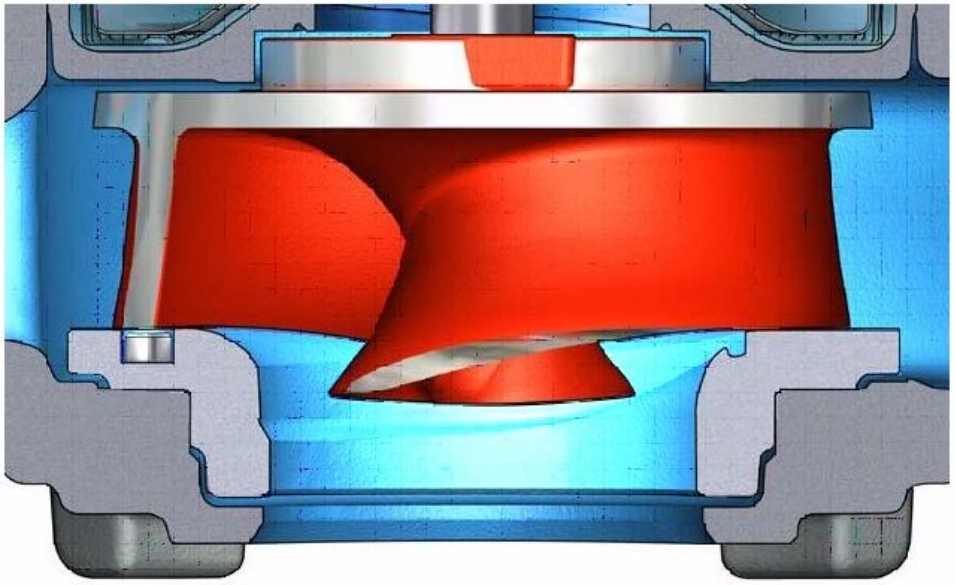
- *(1) To prevent clogging, impeller design is much more important than throughlet size.*

- *(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.*

The Pumping Solution:
Innovative technology in pumping

- **Since 2000, more than 250,000 modern technology pumps in successful operation in the U.S. pumping raw, unscreened sewage and sludge.**
- **Available from 3.0-hp through 800-hp**



Consortium for Energy Efficiency

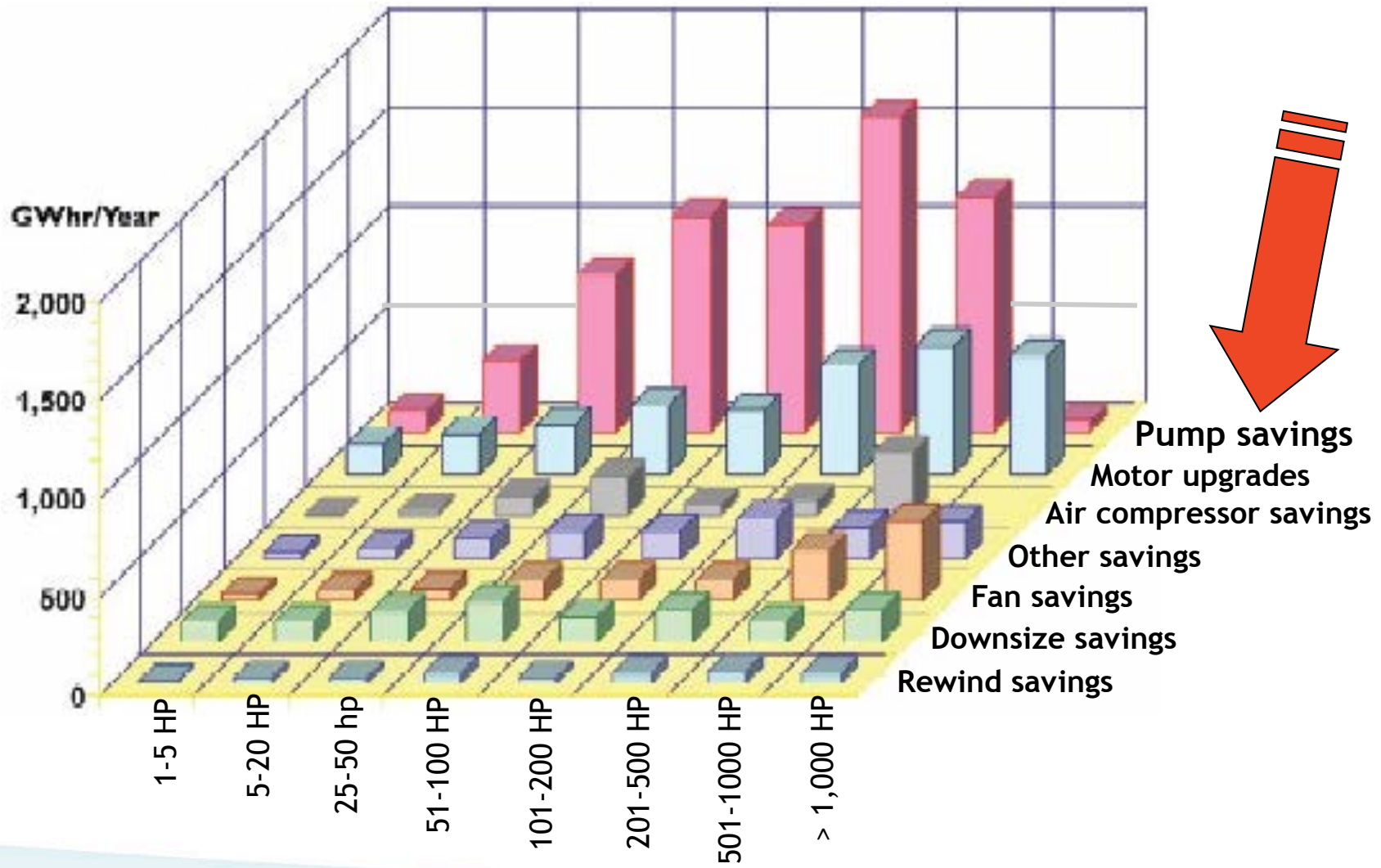
National Municipal Water and Wastewater Facility Initiative

Municipal water and wastewater systems

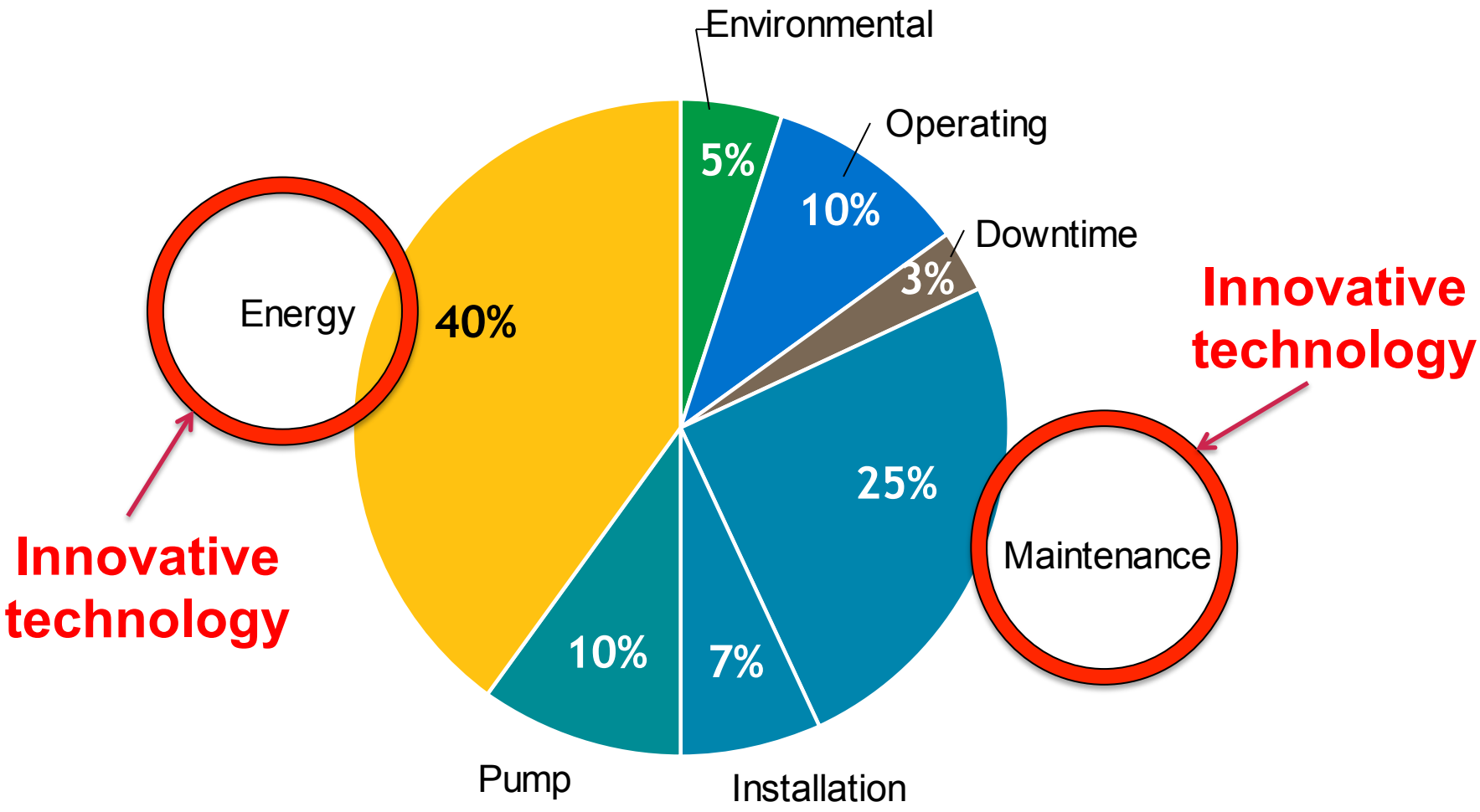
- Consumes 4% of all U.S. energy
- 52,000 water systems produce 51Bn gallons of water per day
- 16,320 wastewater treatment facilities treat 34.8Bn gallons per day
- Greatest energy consumer in water treatment: **Pumps**
- Greatest energy consumers in wastewater treatment are:
  - 1. Blowers
  - **2. Pumps**
  - 3. Sludge handling equipment

Potential energy savings:

By motor hp and application (Source: WEF)



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



Project Review

- Pump Clogging Issues Eliminated
- Operational and Maintenance Savings

Lumberton, TX – Municipal Utility District

Recorded Energy Savings 2003 to 2010

Service area: 63 mi^2 Population: 20,400

	TOTAL KWH USED 2003	TOTAL KWH USED 2004	TOTAL KWH USED 2005	TOTAL KWH USED 2006	TOTAL KWH USED 2007	TOTAL KWH USED 2008	TOTAL KWH USED 2009	TOTAL KWH USED 2010	MONTHLY KWH AVERAGE
January	55,606	56,964	50,255	37,514	31,094	34,634	36,557	40,851	**42,934**
February	40,755	66,788	47,085	37,630	35,428	27,665	30,592	37,602	**40,443**
March	49,954	65,021	53,764	32,389	31,592	25,147	30,450	34,092	**40,301**
April	39,090	46,076	42,973	36,616	33,590	25,475	32,936	26,783	**35,442**
May	33,162	48,028	39,057	43,992	38,722	23,397	30,506	23,601	**35,058**
June	35,148	46,313	36,373	38,052	29,904	28,601	27,274	25,649	**33,414**
July	38,087	51,154	36,462	31,942	30,489	26,140	27,986		**34,609**
August	34,472	36,197	34,307	34,307	30,543	28,240	25,936		**32,000**
September	48,032	37,454	38,620	58,094	26,883	29,643	25,027		**37,679**
October	47,484	35,678	23,844	31,363	29,198	31,503	28,187		**32,465**
November	45,206	40,123	35,595	38,057	39,674	36,557	30,069		**37,897**
December	50,573	52,194	41,674	44,227	39,407	30,592	33,311		**41,711**
YEARLY KWH AVERAGE	**43,131**	**48,499**	**40,001**	**38,682**	**33,044**	**28,966**	**29,903**	**31,430**	
% REDUCTION		**-12%**	**18%**	**3%**	**15%**	**12%**	**-3%**		**32%**

HIGH LOW

REDUCTION IN KILOWATT HOURS OVER TEN

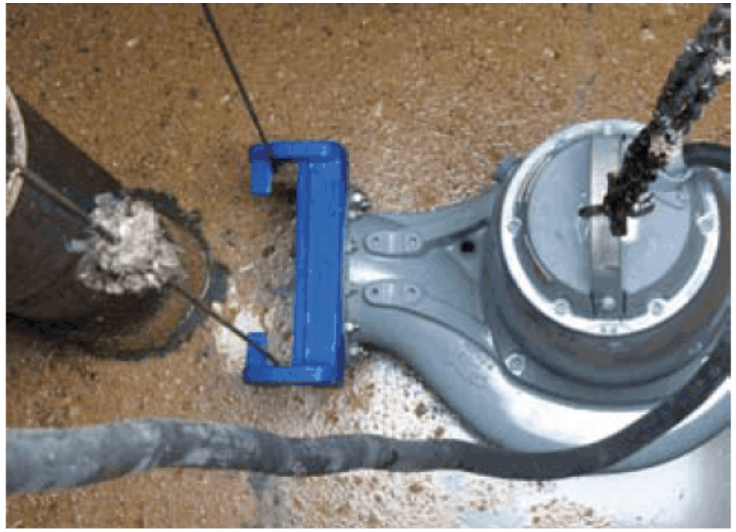
Total Horsepower Increase **37.9%**

Total Kilowatt Reduction

Budget Saving Project Overview

Vancouver, WA – Anderson P.S.

- (4) 40-hp submersible pumps had frequent fouling and clogging
- (4) 25hp modern technology pumps installed
  - $8,000 in maintenance savings – no more pulling of pumps
  - $3,000 in operational savings / energy savings



Recent Energy Saving Project:
City of Andalusia, AL

U.S. DOE Block Grant – Dept. of Economic Affairs
Project spec.: 25% energy savings is required of the contractor

Riverside WWTP

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

Central Lift Station

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

Recent Energy Saving Project

Ypsilanti Communities Utility Authority (YCUA)

- Upgrading several large collection system pump stations
  - Solve clogging issues / Improve hydraulic efficiency / Install ASDs
    - Martz Road P.S. = > 30% energy savings
    - Willow Run P.S. = > 30% energy savings
    - Snow Road P.S. = > 40% energy savings

- Snow Road Pump Station
  - (5) 12-in, NT-3312 / 470-hp pumps Result: **> 40%** Energy Savings
    - **DTE Energy Savings Rebate Program awards YCUA: $65,378!**

INDA Laboratory FG507

WEF Sponsored Pump Clog Testing

WEF Non-dispersable Pump Clog Testing
INDA FG507 Pump Clog Test

Professional Pump Clog Test Rig

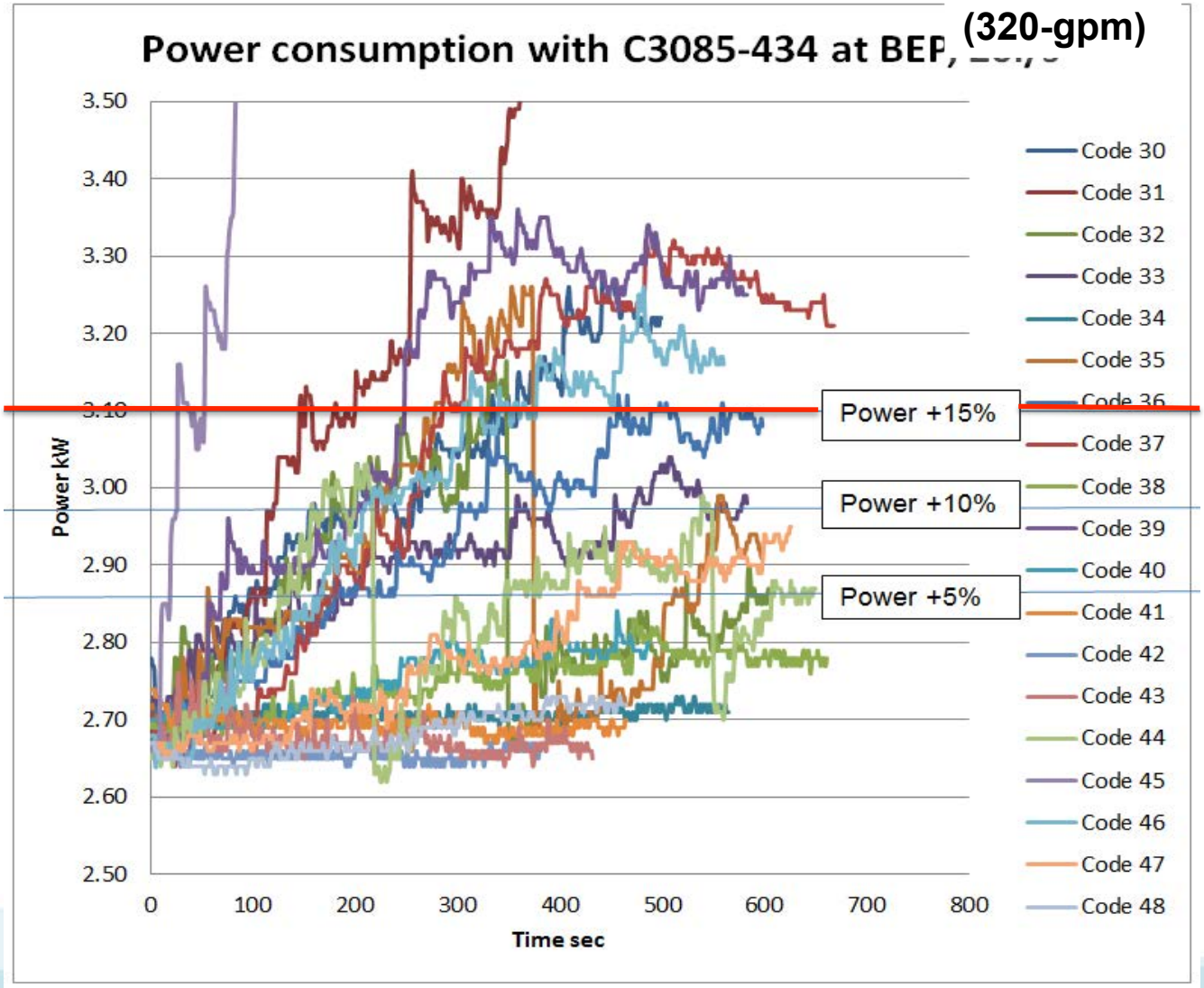
60-min soak / 60 Test articles

Test articles

Feeding 60 Test articles into pump unit

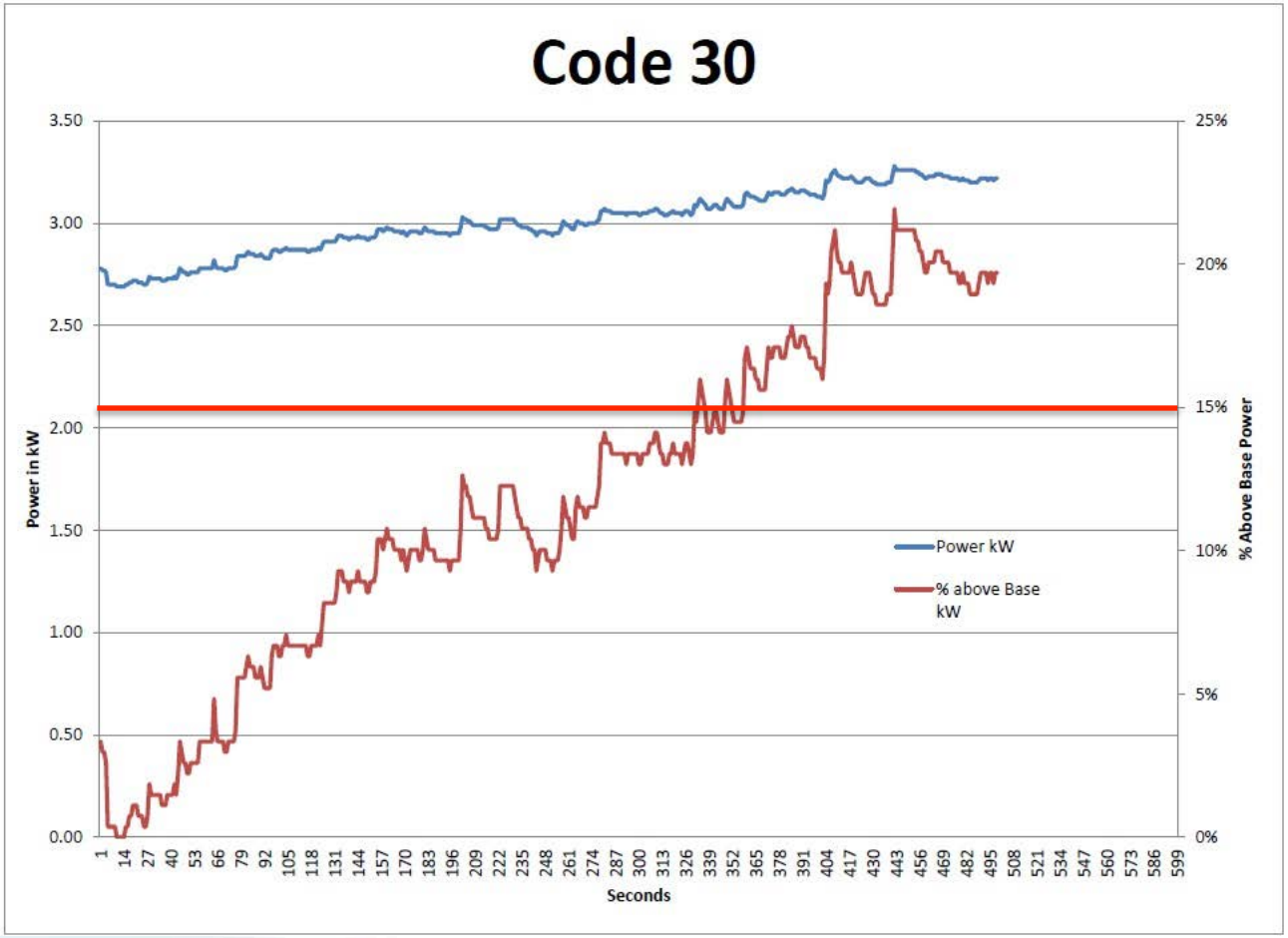
WEF Non-dispersable Pump Clog Testing

Consolidated test results



WEF Non-dispersable Pump Clog Testing

Suominen *HydraSpun*™ substrate – "Flushable" (Walmart / Walgreens)

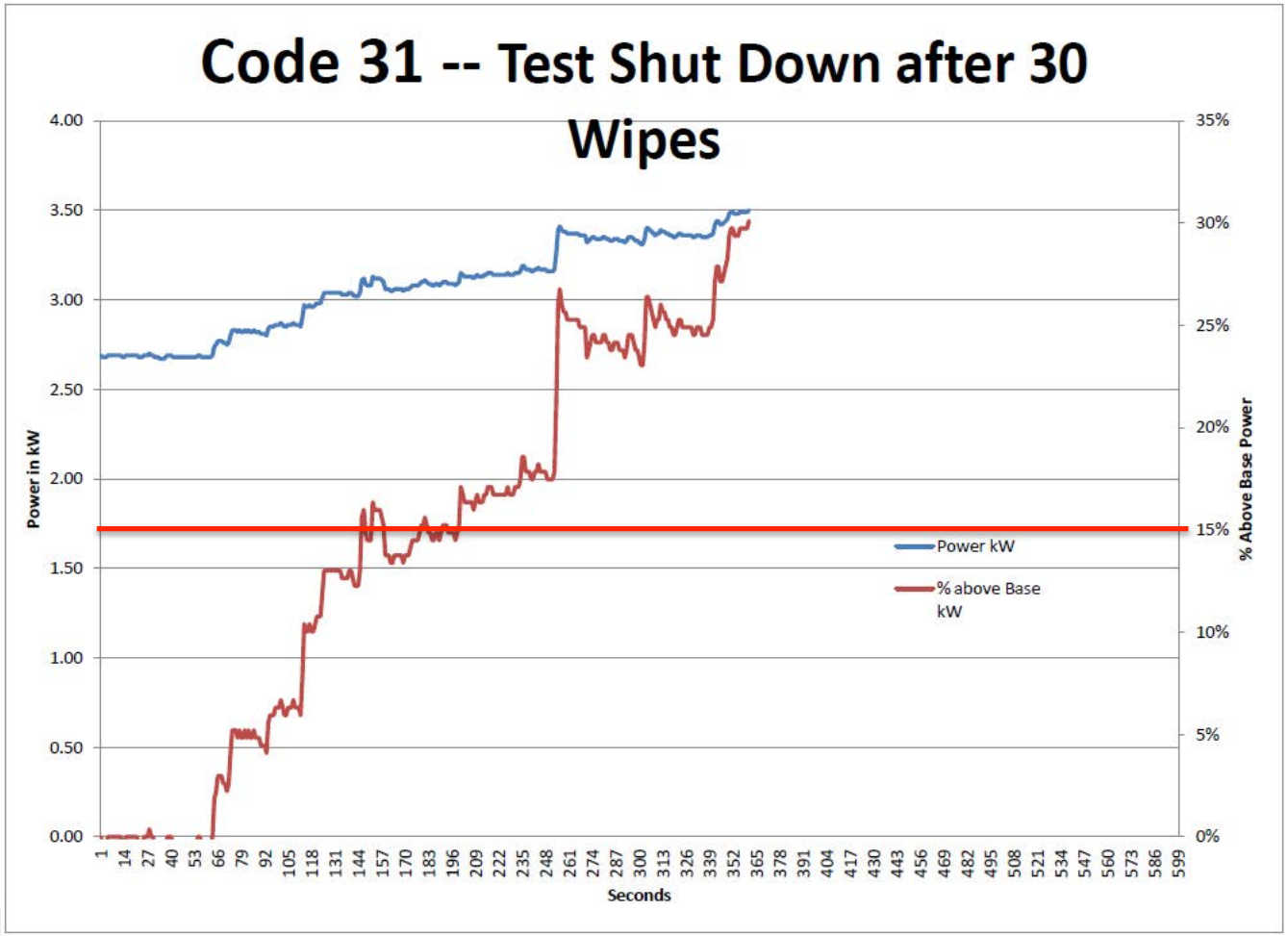


+15%

Fail per FG507

WEF Non-dispersable Pump Clog Testing

U.S. Non-woven (Unknown substrate) – *Smart Sense* (Kmart)

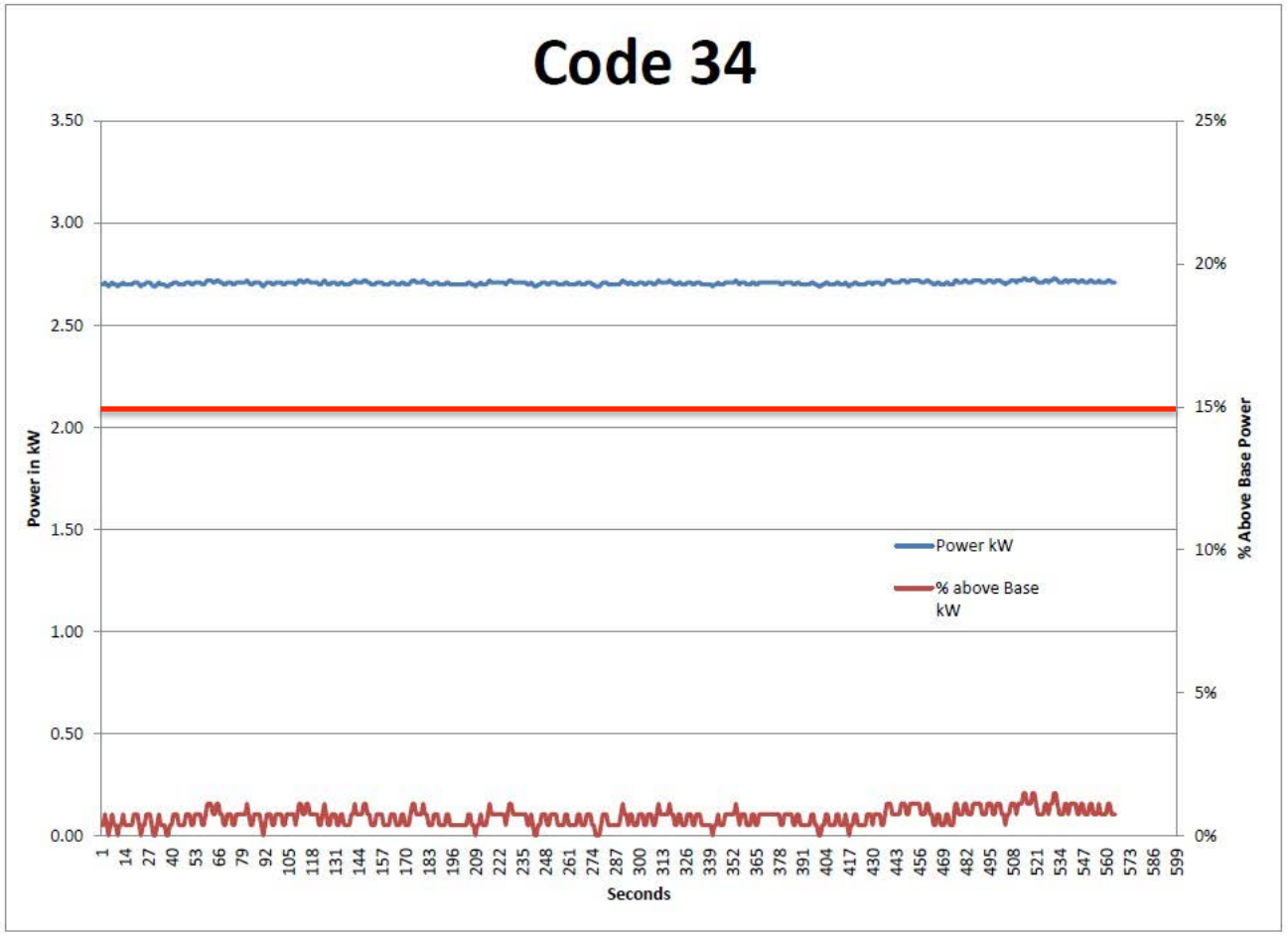


+15%

Fail per FG507

WEF Non-dispersable Pump Clog Testing

Kimberly-Clark '*Safe-Flush*' Technology (Flushable)

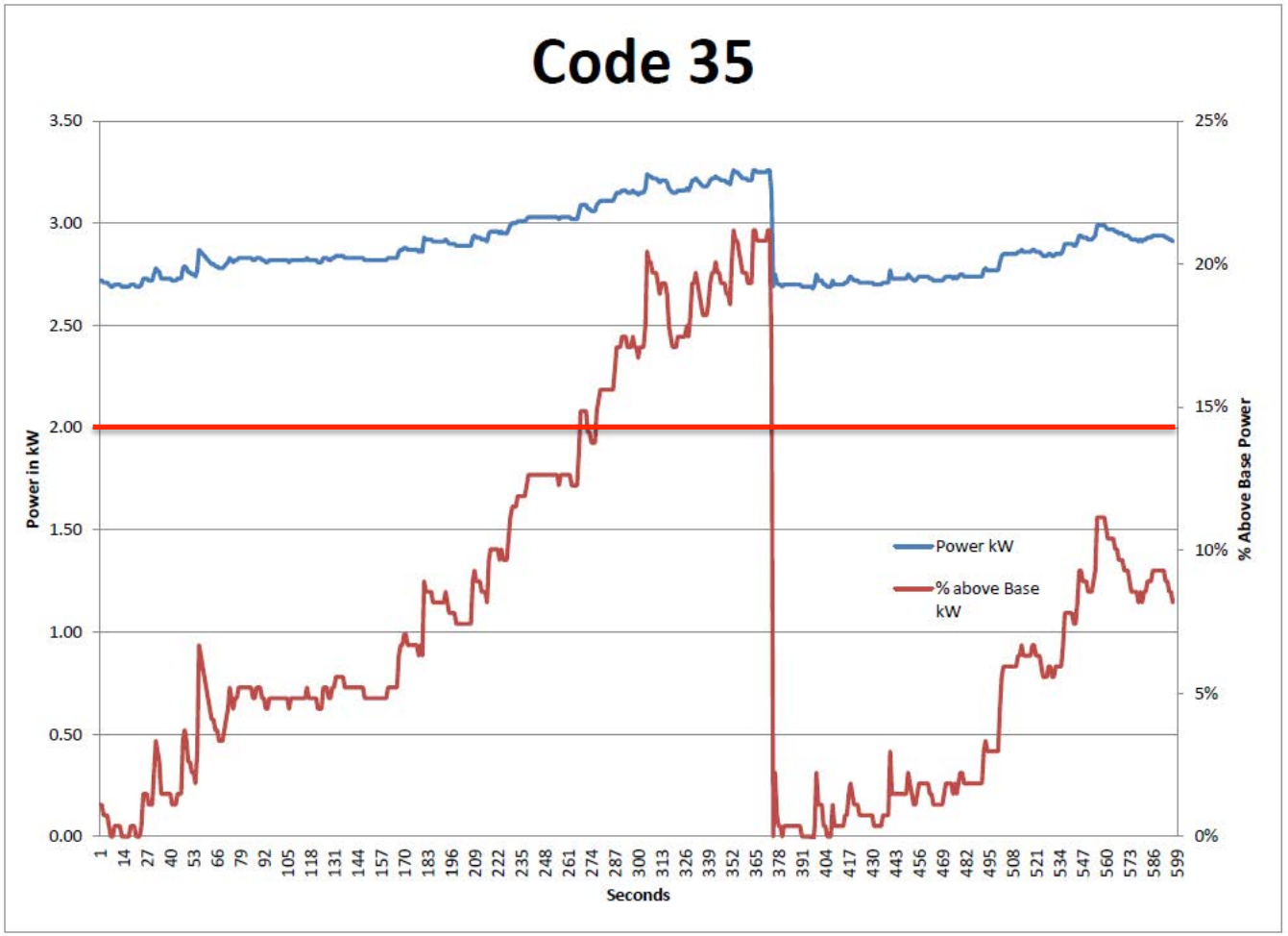


+15%

Pass per FG507

WEF Non-dispersable Pump Clog Testing

Nice-Pak *EcoFlush* Technology – Nice ‘nClean (Flushable)

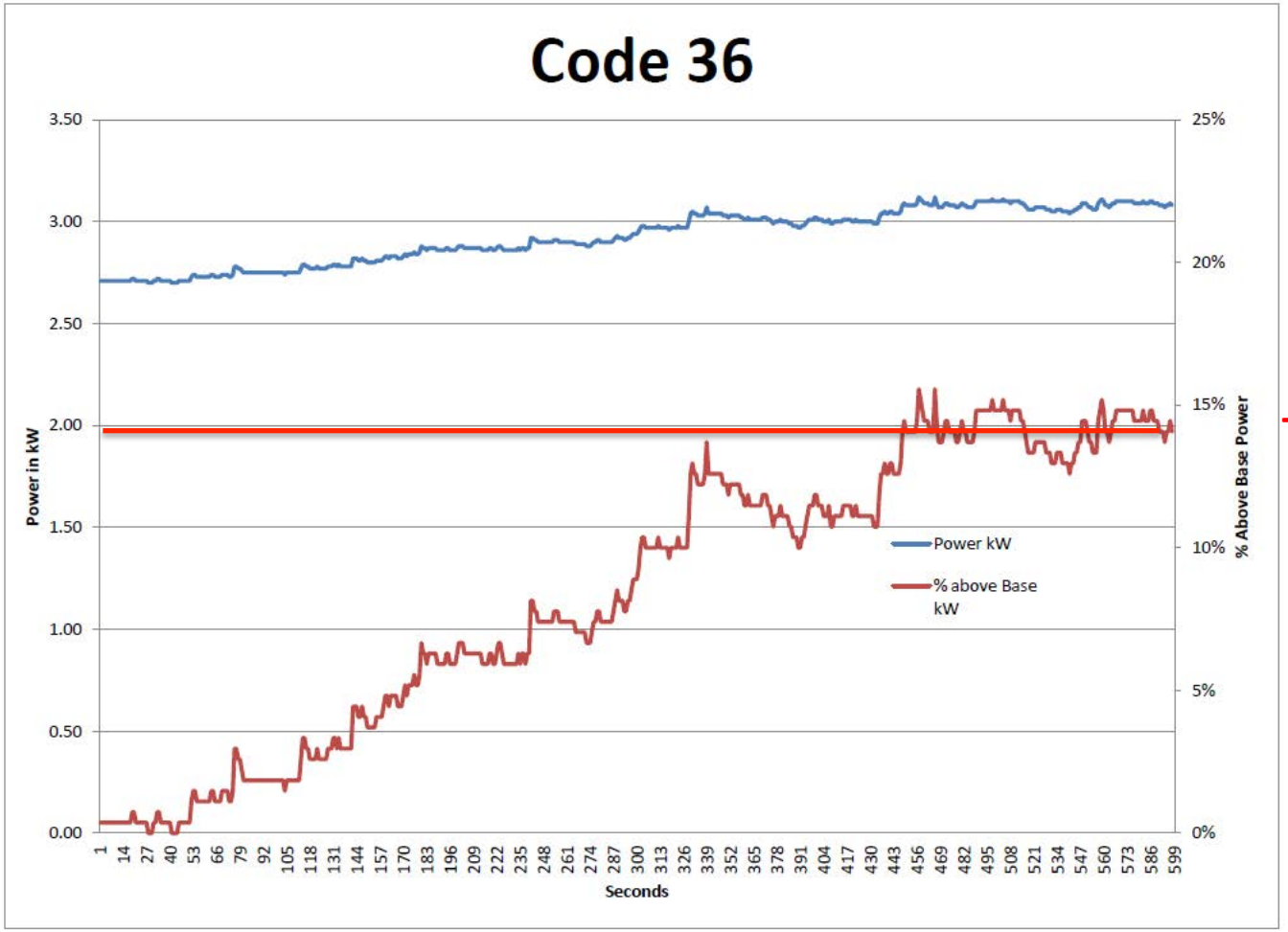


+15%

Fail per FG507

WEF Non-dispersable Pump Clog Testing

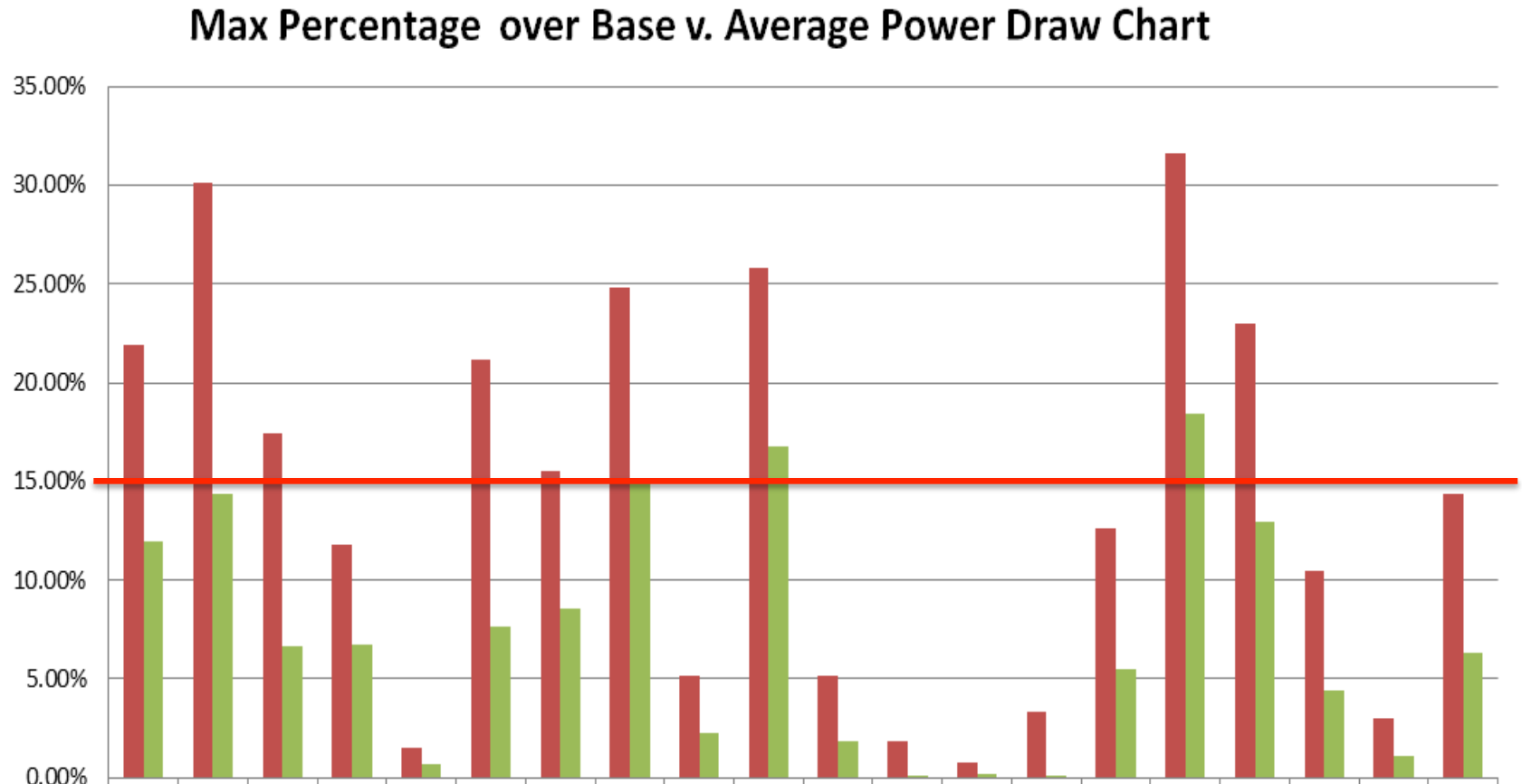
Nemeiah "*Kandoo*" (Flushable)



+15%

Fail per FG507

WEF Non-dispersable Pump Clog Testing Power draw chart – 20 samples

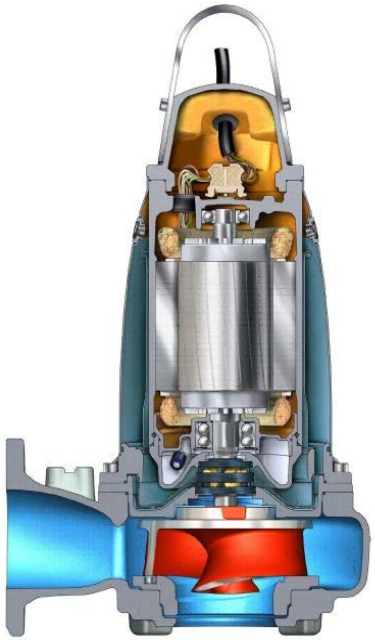


	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	35-2
Max % over Base	21.93%	30.11%	17.47%	11.76%	1.49%	21.19%	15.56%	24.81%	5.20%	25.84%	5.19%	1.86%	0.75%	3.37%	12.64%	31.60%	23.02%	10.49%	3.02%	14.39%
Average Power Draw	11.96%	14.40%	6.64%	6.71%	0.66%	7.67%	8.59%	15.13%	2.28%	16.79%	1.87%	0.15%	0.16%	0.15%	5.51%	18.43%	12.98%	4.46%	1.12%	6.36%

Modern Trash:
Current utility choices

Grind it

Pump it



Screen it

Wipes: Grind It

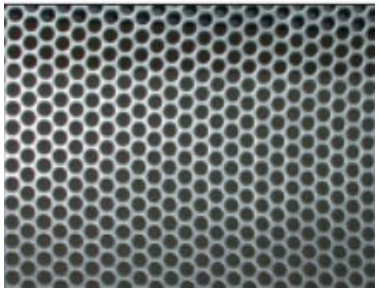
- Comminutor manufacturers' - improved designs
  - Minimize long material string passage
  - Promote smaller square cuttings

- Newer lift-station products
  - Combination comminutor products
    - Screens w/ vertical augers

- Where do you remove the material?

Wipes: Screen It – Current Guidelines

- **Screening systems - improved designs**
  - **Perforated screens (25mm / ½-in) diameter**
    - **Constant brush-cleaning**
    - **High pressure water wash**
  - **Bar screens (25-mm / ½-in) wide**
    - **Frequent cleaning**



Putting It All Together

- 'Modern trash' / non-woven sheet goods have became the No. 1 enemy of collection systems
- Conventional solids-handling pumps *(Wood Trash Pump)* proven not to be able to handle 'modern trash'
- Public education so far seems to have a limited benefit
- Maintenance budgets are strained due to needs to repeat pump pulling/cleaning actions
- Problem is getting worse each month
- Proven pump, grinding and screening solutions exist that greatly minimize maintenance and deliver sustained efficiency

"Grind It, Pump It, Screen It… Update to the Current Status of Wipes Testing and Handling of Modern Trash"

Bob Domkowski
Engineering Consultant
Xylem, Inc. – Flygt Products