Wastewater 101

Understanding Your Hidden Assets

Presented by: Indiana Water Environment Association

WELCOME TO A NEW WAY OF VIEWING THE WORLD OF WASTEWATER

To understand wastewater you only have to understand how the human body functions

Goal:

To help you understand the complexity and value of wastewater treatment processes by relating them to processes of the human body.

Annual Check-Ups For Humans = Preventative Measures for Wastewater

Each person has their own health regimen and each town/city has its own preventative measures for wastewater systems.

Upper GI – looks for abnormalities from the waist up

Dye testing/smoke testing – to find inflow or infiltration (sources of ground water) from the homes to the plant or cross connections or leaking manhole covers

Lower GI – looks for abnormalities or blockages using cameras

Televising – looks at conditions of the sewers using cameras

Cholesterol Check – Cholesterol can block your arteries or break off causing stroke or death

Fats, Oils and Grease (FOG) Program – FOG can block sewers or make its way to the lift stations or treatment plant causing further problems

EKG – Records the electrical activity of your heart (which keeps the blood flowing)

Lift Station Check/Maintenance –

To make sure the lift station is in good condition to keep the sewage flowing to the plant

Teeth Cleaning and Annual Check Up

Preventative maintenance on sewer maintenance vehicles used to clear roots/debris from sewage lines

Eye Exam

Visual inspections looking for sink holes, collapsing manholes, cross connections, overall cleanliness

Dermatologist

Street sweeping the surface to prevent future plugs in sewers

Picture Courtesy of Best Equipment

Industrial Pretreatment

The treatment of wastewater by industrial facilities to remove harmful pollutants before discharging to the sewer system under the control of a publicly owned treatment works (POTW)

Industrial Treatment Facilities

Humans should be careful about what they put into their bodies.

The Pretreatment Program was established to monitor and control what goes into the POTW

RESULTS OF NO PRETREATMENT PROGRAM

In years past most people only sought out a doctor when they were sick or dying, when they could see or feel the problem.

Communities were not concerned with industrial discharges unless you could see the problem. Sites such as this were common; rivers and streams ran brown, red, green with odors and dead or dying fish.

Comparisons Begin

Human	Pretreatment
Interaction of prescription drugs • Sometimes unfavorable reactions (hallucinations, hives) • Become toxic resulting in death	Industrial discharges can cause unfavorable reaction in the collection system or plant • Solids not settling properly, clumps of sludge in effluent • Kill off plant
Hair in nose filters air going into the lungs	Pretreatment program keeps bad things from getting into the collection system and wastewater treatment plant

Pretreatment

Safeguarding the Body

To protect your whole well-being we try to follow certain "rules" :

- ✓ Exercise daily
- ✓ Follow a healthy diet
- ✓ Take prescription drugs as prescribed
- ✓ Don't smoke
- ✓ Don't overindulge in drinking
- ✓ Wear your seat belt

Some are common sense, some are laws.

Safeguarding the POTW

To protect the POTW the Pretreatment Program must set certain "rules" as well :

- ✓ Sewer Use Ordinance
- ✓ Local Limits
- ✓ Enforcement Response Plan
- ✓ State and Federal Regulations
- ✓ Site Specific Permits

This is the muscle of the Pretreatment Program

Comparisons continued

Human	Pretreatment
Pretreatment is like a food quality check • Ensuring the food we put in our body is safe for the body to process	A wastewater treatment plant that receives too much pollution will have upsets and won't work correctly
Illegal drugs kill	Meth labs dump into the sewer systems and the chemicals kill our treatment facilities
Overdose or wrong type of prescription drugs can adversely affect you	A normal treatment facility doesn't treat for pharmaceuticals and they flow through to the environment

Problems Can Develop

Fish Kill
Results of a Toxic Release

Results of Surfactants
(Detergents) in the Plant

Collection System

Configuration of inlets, catch basins, manholes, pipes, drains, mains, holding basins, pump stations, outfalls, controls and special devices to move wastewaters from points of collection to discharge. This system is also known as the collection system.

Comparisons

Human

The skin is the largest organ of the body made up of multiple layers of tissue; it guards the internal organs.

(*Skin* is the wrapper)

- Microderm abrasion removes dead/decaying skin that blocks pores

Collection System

Moves water (waste and storm) like blood through the system. It is the largest component of the POTW

(*Sewer Pipes* are the wrapper)

- Street Sweeping keeps the roads and catch basins clear of debris that could cause sewers (storm or combined) to back up

Comparisons – Collection System

Human	Sewers
The heart is divided into halves having two different functions.	There are three types of sewers, sanitary, storm and combined, all carrying different types of flow.
If the arteries of the heart are plugged, an angioplasty is performed reestablish blood flow.	If the sewers are plugged, you call Roto-Rooter or the city to use their vacuum truck/root saw to clear the lines resuming the flow of wastewater.
Veins carry blood at lower pressures	Force-mains move wastewater from the lift station under pressure Gravity sewers allow wastewater to flow by gravity to the lift station or plant

Comparisons – Collection System

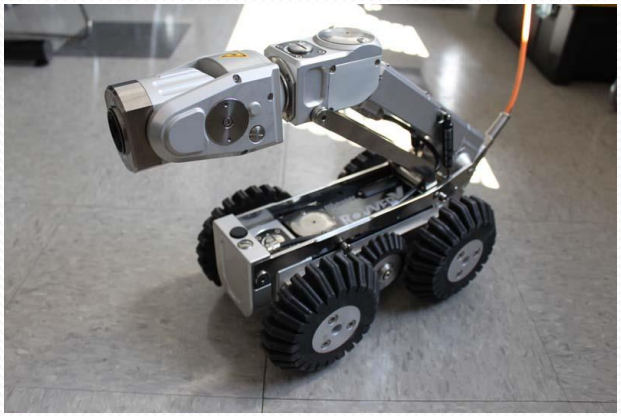
Human

- Arterial disease repair
- Angioplasty
- Heart Disease
- Open heart surgery

Collection System

- Deteriorating pipes
- Cured in place pipe lining
  - costs range from $24 per ft to over $100 per foot depending on pipe size
- Sewer collapse
  - $60-$70 per foot to replace
- Open cut repair
  - costs range in price $5000 to $25,000 per repair location

Preventative Maintenance Equipment



← **Portable Camera**

Vacuum Truck $280K →

Camera Truck $120 K

Street Sweeper $70 – 100K

Photos courtesy of Best Equipment

Problems Found In Sewers

Mineral Deposits at Leaning Lateral

Mineral "Stalactite" at Leaking Pipe Joint

More Problems In Collection System

Lift Stations - Grease

Sanitary Sewer Overflows

Credit: Alan Cressler

Failure of Preventative Maintenance

Tree Roots Invading Sewer

Laying New Sewer Pipes

Cure In Place

Keeping It Off the Streets and Out of the Sewers Is a Team Effort

Street Sweeping
Street Repairs
Trash Removal
Large Debris Removal
Recycling
Stormwater MS4

Photos Courtesy of Best Equipment

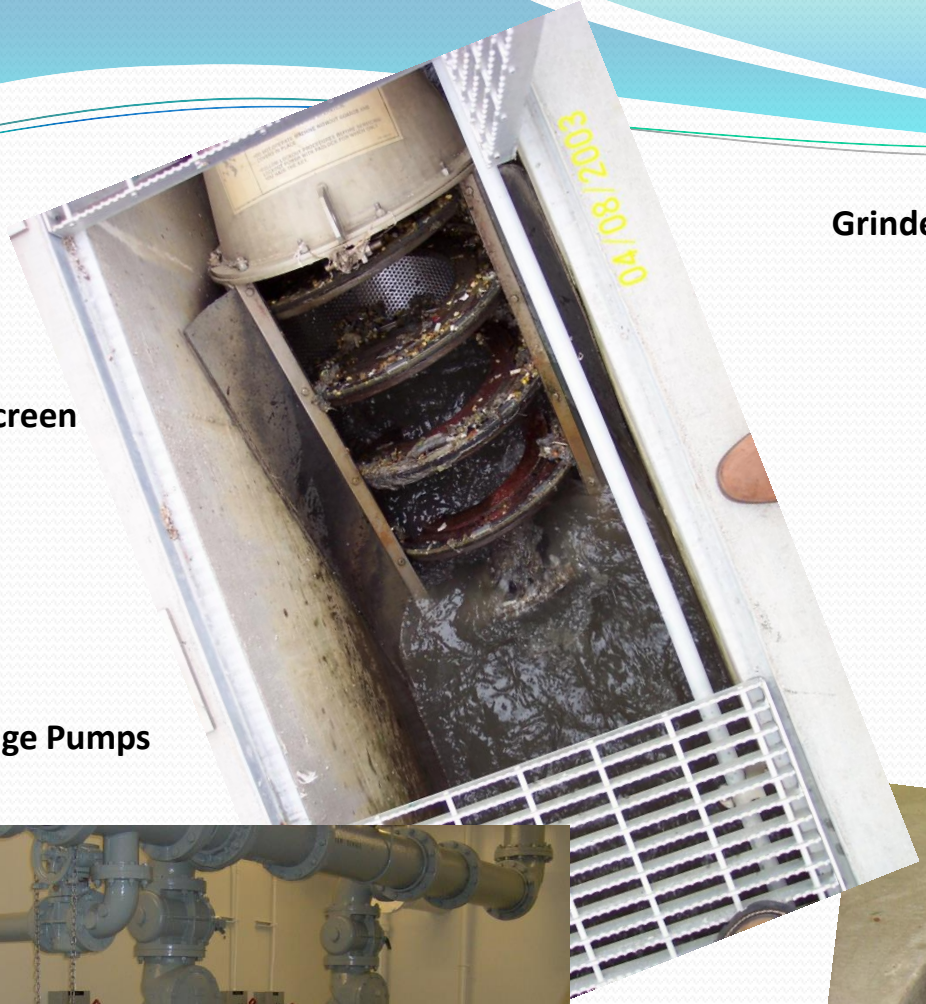
Treatment Facility

Processing facility that physically, biologically and chemically modifies wastewater characteristics enabling it to meet effluent standards.

Comparisons – Treatment Facility

Human	Treatment Facility
Chewing food • choking from too large of pieces • also remove larger pieces that can't be chewed	Grinding large debris found in sewers or removing large debris that can't be ground • Channel Monster, Comminutor • Bar screens, bar racks
Heart pumps blood to organs • Heart attack ✓ Defibrillator ✓ By-pass surgery ✓ Pace-maker	Raw Sewage Pumps deliver flow to the rest of the plant • Pump quits ✓ Redundancy ✓ Back up generator

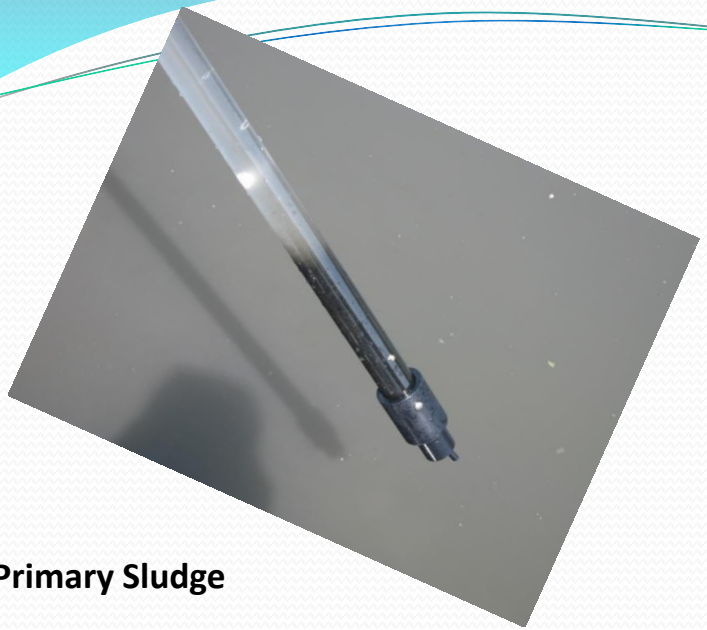
Hycor Bar Screen



Grinder

Raw Sewage Pumps

Fine Screen Bar Screen



Primary Sludge

Primary Clarifier

Grit removal

Comparisons – Treatment Facility

Human	Treatment Plant
Bacteria is present in our body, but mainly in the stomach and intestines.	Bacteria are present throughout the plant, but mainly in the aeration basin or biological treatment process and the digesters
We need oxygen to breath and the lungs help provide this oxygen.	The bacteria/microorganisms in the biological section need oxygen to breath • Some plants use blowers others use mixers to provide dissolved oxygen

Comparisons – Treatment Facility

Human

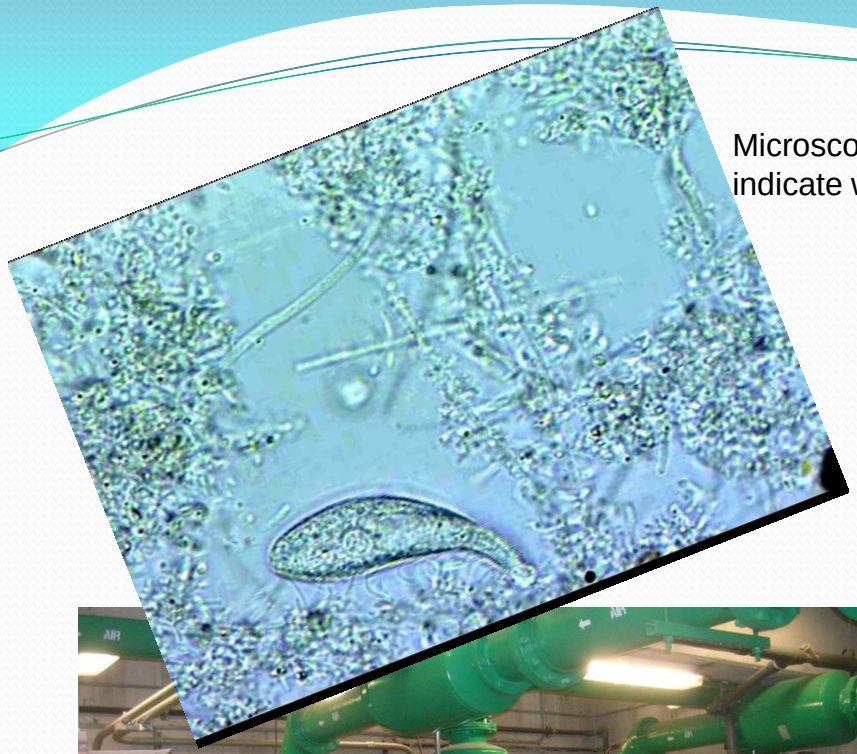
- Food is needed to survive
  - The amount of food is important or we can become obese or anorexic.

The type of food is important, we need a good mixture of all food groups with very little fats.

Treatment Facility

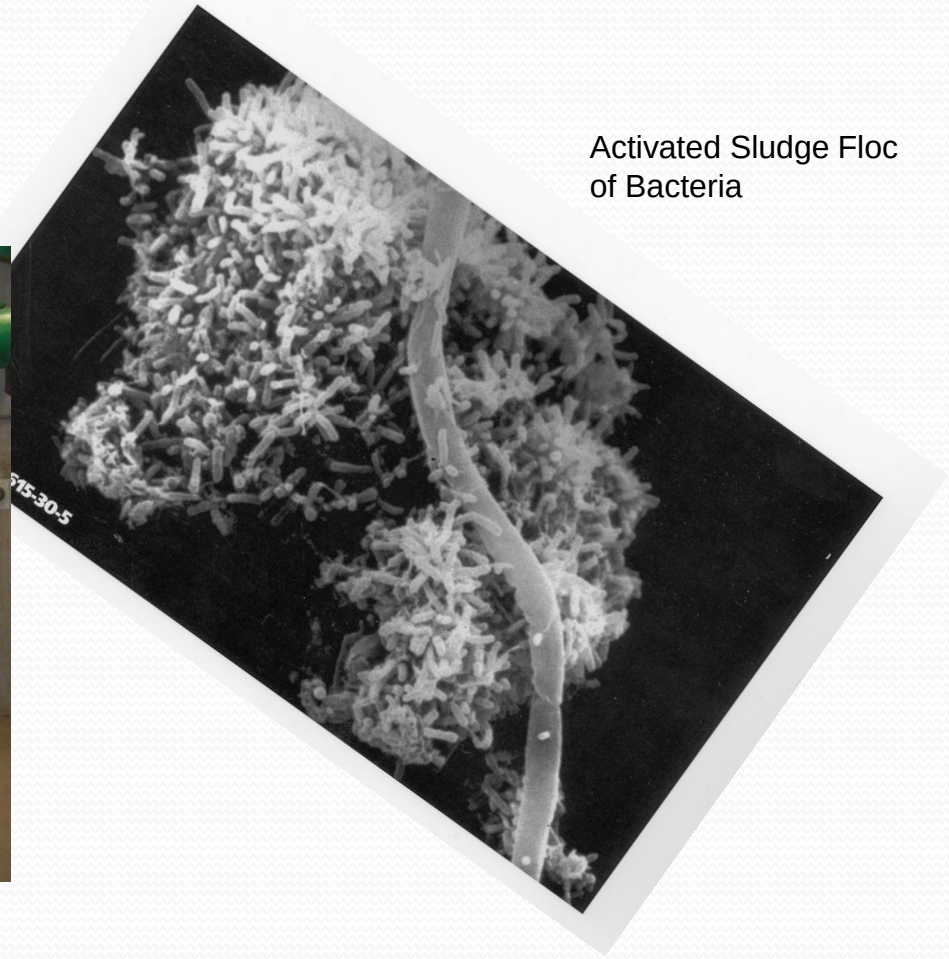
- Bacteria need food in order to survive
  - The amount of food is important or the plant can have too many bacteria or too few bacteria.

The type of food is important, the bacteria need a supply of BOD (organic material, phosphorus and nitrogen with very little fat.



Microscopic Organisms that indicate what bacteria is present

Blowers



Activated Sludge Floc of Bacteria

Secondary Treatment

Oxidation Ditch

Sequencing Batch Reactor

Trickling Filter

More Secondary Treatment

Rotating Biological Contactor

Vertical Loop Reactor

Activated Sludge Aeration Basin

Biolack

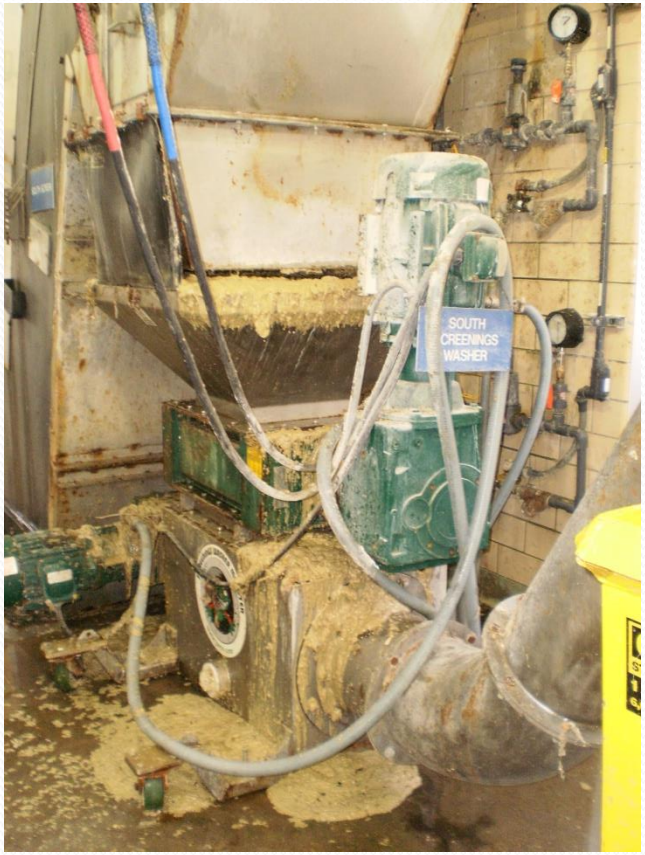
Comparisons - Treatment Facility

Human	Facility
Kidneys filter out cellular wastes	Tertiary Treatment filters out the solids that other treatments can't
Immune system destroys and removes invading microbes and viruses from the body • Herbs • Vitamins	Disinfection destroys the pathogenic (disease causing) bacteria • Chlorine • UV
Nervous System sends signals to control actions/functions	Instrumentation and Controls – sends signals to control actions /functions
Skeletal System – support for the body to protect organs	Utility Buildings, Structures and Land – supports the wastewater system

Tertiary Treatment

Problems Develop in Preliminary Treatment

Dry Pit Pump Basement



Excessive Grease in Bar Screen

Problems Can Develop In Primaries

Problems in Secondary Treatment

Aerator

Secondary Clarifier

Problems in Secondary Treatment continued

Equipment or Instrumentation Problems

Solids Handling

Sewage sludge is a mixture of wastewater and settled solids which must be treated to facilitate its disposal.

Solids handling is the process by which sewage sludge is treated.

All of the various treatment processes have two main objectives:

(1) to reduce the volume of material to be handled by removing as much liquid as possible, and

(2) to decompose organic matter to a more stable form from which water will separate more readily.

This is called digestion which results in a reduction in the total solids. Treated sewage sludge is called “Biosolids”.

Comparisons – Solids Handling

Human	Facility
Body consumes food for nourishment	Wastewater enters treatment system
Food is digested • Digestion: the body's process of breaking down food and drink into their smallest parts using them to build and nourish cells and to provide energy	Sludge is digested • A biological process in which organic solids are decomposed into stable substances
• Digestion begins in the mouth, when you chew and swallow, and is completed in the small intestine	• Digestion reduces the total mass of solids, destroys pathogens, and makes it easier to dewater or dry the sludge

Anaerobic Digester - Comparisons

Human	Digester
One sign of health is a steady temperature of 98°F	Maintain a temperature of 95°F to 98°F for healthy digester

Bacteria do the digestion

Food must be macerated for the bacteria to utilize

The upper part of the stomach creates an acid to break down the food	The first stage of digestion is acid formation
The lower part of the stomach begins creating gas (methane)	The second stage of digestion is gas formation (methane)
The colon provides a place for solids liquids separation	A secondary digester provided a place for solids liquids separation

Anaerobic Digesters

Aerobic Digesters - Comparisons

Human	Digester
We need air to breath – some need oxygen tanks	The bacteria need air to work – air is supplied
When there are too many people in the workforce, retirement is encouraged	When there are too many bacteria and the sludge is considered (old) we send some of the bacteria to the digester
Eat smaller meals, spread through out the day	Feed smaller amounts, through out the day
No longer reproductive	Don't want them to reproduce

Aerobic Digesters

Rectangular

Round

Comparisons – Solids Handling

Human

Waste products of the digestive process include undigested parts of the food, and older cells.

These materials are pushed into the colon, where they remain until the feces are expelled.

Facility

Treated sludge (biosolids) must be removed from the plant so that the plant will continue to operate properly

Digested (treated) sludge is removed from digester for dewatering or disposal

Comparisons – Solids Handling

Human

- A person should have their blood and urine analyzed yearly as a check to verify the body is functioning properly

Facility

- Biosolids should be analyzed at least yearly to verify the quality to ensure the plant is functioning properly

Dewatering Methods

Filter Belt Press

Drying Bed

Geotube

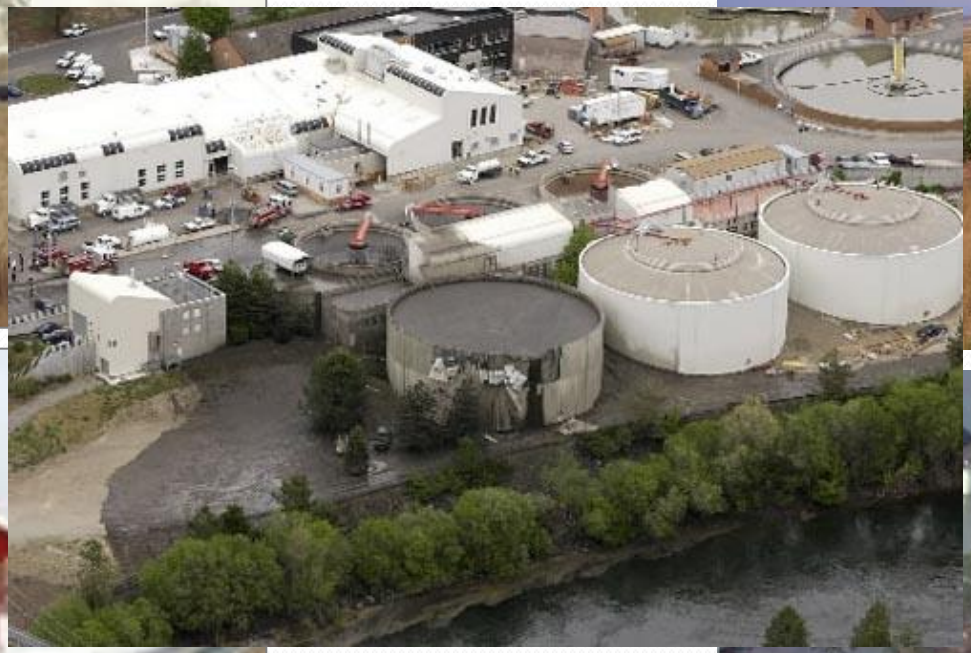
Final Disposal of Biosolids

Dewatered Sludge from Belt Presses to Landfill

Land Application of Liquid Biosolids

Land Application of Dry Biosolids

More Problems



Laboratory

Laboratory work is like a thermometer or pulse rate check.

Measurements of the body tell us how well it is working.

Laboratory measurements are a check of how well the wastewater treatment plant is working.

Comparisons - Laboratory

Human

- Daily blood sugar testing
- Daily blood pressure testing
- Checking for a fever

Laboratory

- BOD, Ammonia testing
- Phosphorus testing
- Checking the pH

Routine monitoring of system health

Comparisons - Laboratory

Human

- Proper hygiene and cleanliness of the body leads to better health and less sickness
- Drawing & testing blood

Laboratory

- Proper maintenance and calibration of equipment leads to more accurate results and less contamination
- Collecting & analyzing wastewater

Problems Can Happen In a Lab

- Have to send the samples out and don't get the results for a week or so
- Bad or inadequate samples taken
- Inadequate testing equipment
- No meter calibration

Safety

The wastewater treatment industry has three major safety concerns: confined space entry; lockout/tagout; and personnel protective equipment (PPE). All three safety concerns cover very specific issues and all are equally important. As well as OSHA's General Duty Clause.

In the wastewater-treatment industry, recognizing the potential hazards of confined spaces are a major threat and can mean the difference between life and death.

Safety Training =$
No Safety Training = $$$

Housekeeping

Site Emergency Plant

Fall Protection

Traffic Safety

Atmospheric hazards

Bloodborne Pathogens

DROWNING

Written Safety Program

Laboratory Safety

Lockout/Tagout

Chemical Hazards (Hazcom)

First Aid Training

ARC Flash

Slips/Trips

Personal Protective Equipment (PPE)

Confined Spaces (permitted and non-permitted)

Trenching/Shoring

First Responder Training

FORKLIFT SAFETY

Lifting/Back Protection

Spill Response

Waterborne diseases

Hand Tool Safety

Accident Reports

CPR Training

Fire Extinguisher Safety

Overhead Crane Safety

ERGONOMIC

Miscellaneous BUT IMPORTANT

Personnel

Costs

Comparisons - Personnel

Primary Physician	Operator
Must be certified	
Must receive continuing education in their field	
Must learn to diagnose symptoms	
On call 24-7	
Refers patients to others for further medical treatment or blood work	Many times is the collection system operator, pretreatment coordinator, lab tech, electrician and the maintenance/laborer as well as being the operator
Answers to the Medical Board, Patient	Answers to the City/Town Board/Mayor, EPA, IDEM, Public, IOSHA
Good pay for their work	Many times are underpaid for their work

Monthly Report of Operation
Activated Sludge Type
Wastewater Treatment Plant
State Form 10829 (R3 / 11-08)

Name of Facility		Permit Number	
Muncie WPCF Outfall #021A		IN0025631	
Month	Year	Plant Design Flow	Telephone Number
September	2011	24 mgd	765/747-4864
Facility's e-mail address (if available):		munciesanitary.org	
Certified Operator: Name		Class	Certificate Number / Expiration Date
John C. Barlow		IV	10840 / 6/30/2012

							CHEMICALS USED			RAW SEWAGE								
Day Of Month	Day of Week	Man-Hours at Plant (Plants less than 1 MGD only)	Air Temperature (optional)	Total= 3.91 Precipitation - Inches	Bypass At Plant Site ("X" If Occurred)	Collection System Overflow ("X" If Occurred)	Chlorine - Lbs	SO2 - Lbs Gal./Day	POLYMER - Lbs/Day or Gal./Day	Influent Flow Rate (if metered) MGD	pH	CBOD5 - mg/l	CBOD5 - lbs	Susp. Solids - mg/l	Susp. Solids - lbs	Phosphorus - mg/l	Ammonia - mg/l	
1	Thu			0			477	800	54.1	13	7.5	196	21250	187	20275		14.2	
2	Fri			0			507	800	60.2	13.2	7.4	134	14752	160	17614		15	
3	Sat			0.07			482	800	60.2	12.7	7.4	137	14511	165	17476		13.6	
4	Sun			0.01			516	800	68.8	12.7	7.3	151	15994	297	31458		12.8	
5	Mon			0			450	800	83.4	12.5	7.4	151	15742	178	18557		13.6	
6	Tue			0			462	800	351.8	13.1	7.5	161	17590	630	68830		14.9	
7	Wed			0.36			548	800	387.9	15.3	7.4	150	19140	290	37005		12.8	
8	Thu			0.18			633	800	304.3	16.8	7.5	208	29143	1230	172338		12.4	
9	Fri			0.03			500	800	344.2	14.1	7.4	118	13876	176	20697		11.3	
10	Sat			0.01			471	800	60.2	13.3	7.4	120	13311	150	16638		13.9	
11	Sun			0.18			464	800	68.8	13.6	7.5	142	16106	170	19282		14.6	
12	Mon			0.01			502	800	341.8	13.5	7.5	141	15875	150	16889		13.6	
13	Tue			0			523	800	349.4	13.5	7.5	153	17226	223	25108		14.7	
14	Wed			0.19			512	800	372.5	13.4	7.3	151	16875	273	30509		15.2	
15	Thu			0			566	800	364.6	14.2	7.5	212	25107	250	29607		15.2	
16	Fri			0			508	800	204.8	13.1	7.5	162	17699	160	17481		15.8	
17	Sat			0			508	800	68.8	12.5	7.4	117	12197	133	13865		15.6	
18	Sun			0.01			447	800	60.2	12.5	7.4	153	15950	187	19495		16.2	
19	Mon			0.64			780	800	349.4	21.5	7.2	157	28152	273	48952		11.2	
20	Tue			0.01			696	800	265.6	16.3	7.3	136	18488	230	31267	2.74	7.84	
21	Wed			0			528	800	327.3	13.8	7.4	128	14732	182	20947		13.8	
22	Thu			0.13			517	800	334.6	13.6	7.4	152	17240	222	25180		13.9	
23	Fri			0.34			713	800	344.2	19.6	7.2	99	16183	175	28606		10.1	
24	Sat			0.02			517	800	53.3	14	7.5	129	15062	136	15879		12.5	
25	Sun			0.77			627	800	60.2	15.5	7.5	131	16934	163	21071		12.9	
26	Mon			0.43			996	842	349.4	26.8	7.3	115	25704	327	73088		6.42	
27	Tue			0.09			625	845	342.5	17.3	7.4	82	11831	88	12697		7.82	
28	Wed			0.1			512	800	342.7	15.3	7.5	106	13526	153	19523		10.5	
29	Thu			0.29			554	800	374.7	17	7.4	107	15170	108	15312		10.6	
30	Fri			0.04			629	800	60.2	16.4	7.5	89	12173	175	23936		9.4	
Average							559	802.9	227	15.003		140	17251	241	30986	2.74	12.75	
Maximum				0.77			996	845	387.9	26.8	7.5	212	29143	1230	172338	2.74	16.2	
Minimum							447	800	53.3	12.5	7.2	82	11831	88	12697	2.74	6.42	
No. of Data				30	0	0	30	30	30	30	30	30	30	30	30	1	30	0

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Signature of Certified Operator — Date (*month, day, year*)

Signature of principal executive officer or authorized agent — Date (*month, day, year*)

Operators attest to this statement every month

- “I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.”
- Source: 327 IAC 5-2-22(d)

Examples of Costs

- Raw Sewage Pumps – between 20 & 30% of energy demand
- Blowers or other aeration equipment – between 40 & 50% of energy demand
- Unfunded mandates for reducing combined sewer overflows (CSOs) for some communities
  - LTCP Prep Costs - $30,000 to $170,000
  - LTCP Project Costs - $9,000,000 to Billions
- Stormwater (MS4) Program – quality/quantity issue
- Sanitary Sewer Overflow elimination

New Construction Costs

- Clarifier
  - 25’ = $170,000
  - 35’ = $270,000
  - 50’ = $400,000
  - 80’ = $900,000
  - 120’ = $1,600,000

Costs for Dewatering Equipment

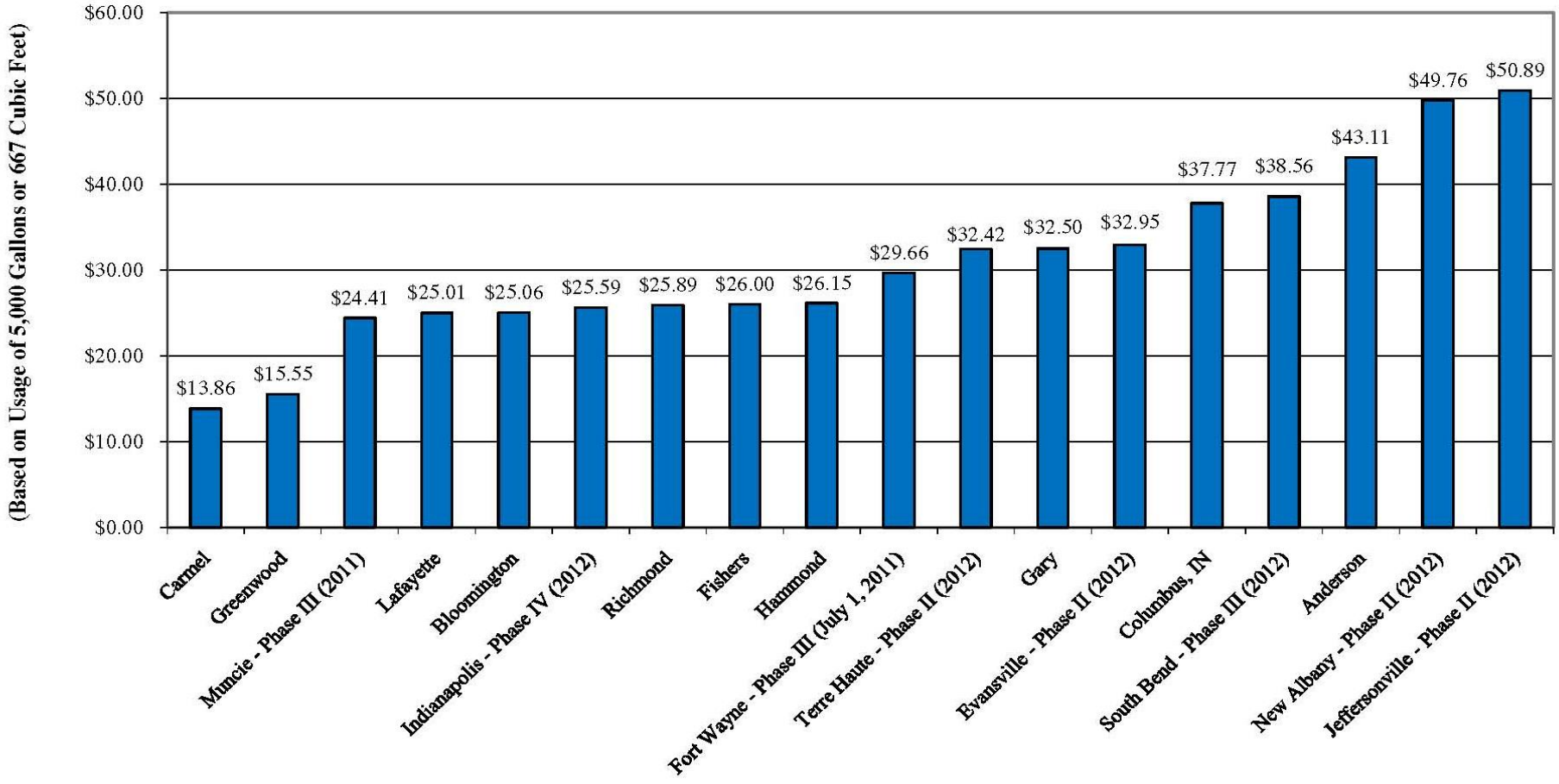
Geotube

- $15,000 for buying equipment (in-house project)
- $100,000 for 3-bay loading pad

Belt Press (package – pumps, polymer system, etc)

- 0.5 meter - $160,000
- 1.0 meter - $210,000
- 1.5 meter - $240,000

COMPARISON OF RESIDENTIAL MUNICIPAL SEWAGE WORKS MONTHLY BILLINGS



The water we have is the ONLY water we ever had or will ever have.

We are not preserving the integrity of water for generations to come – we are cleaning the water for those communities down stream of us to utilize today.

Your wastewater treatment employees (with their various duties and titles) are the protectors of the environment in which we live and the protectors of the environment.

Thank You