ADVANCES IN DISTRIBUTION SYSTEM FIELD MONITORING

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ADVANCES IN DISTRIBUTION SYSTEM FIELD MONITORING

Field Collection Data

Remote Monitoring

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DRINKING WATER SYSTEM TRIVIA

- There are 168,000 public water systems
  - Including 54,000 community water systems serving 264 million people
- 82% of the population receives drinking water from large utilities (serving 10,000 +)
  - However, most systems (86%) are small

DRINKING WATER SYSTEM TRIVIA

- 1,000,000 miles of water pipes in U.S.
- 15,000 miles added each year
- 5,000 miles are repaired annually
- 240,000 water main breaks

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PITTSBURGH 36 INCH MAIN BREAK

- A geyser caused by a severed 36-inch water line erupts from Fort Duquesne Boulevard at about 10:30 a.m., August 17th. One of the largest water main breaks in the city's modern history.

MORE THAN 20 MILLION GALLONS OF WATER POURED INTO NEARBY PARKING GARAGES AND OTHER LOW-LYING AREAS.

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A DRIVER WHO WAS ABLE TO RESCUE A VEHICLE FOLLOWS A MAN ON FOOT OUT OF A FLOODED GATEWAY CENTER PARKING GARAGE.

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- **Workmen do preliminary work before the water main break can be repaired in downtown Pittsburgh.**

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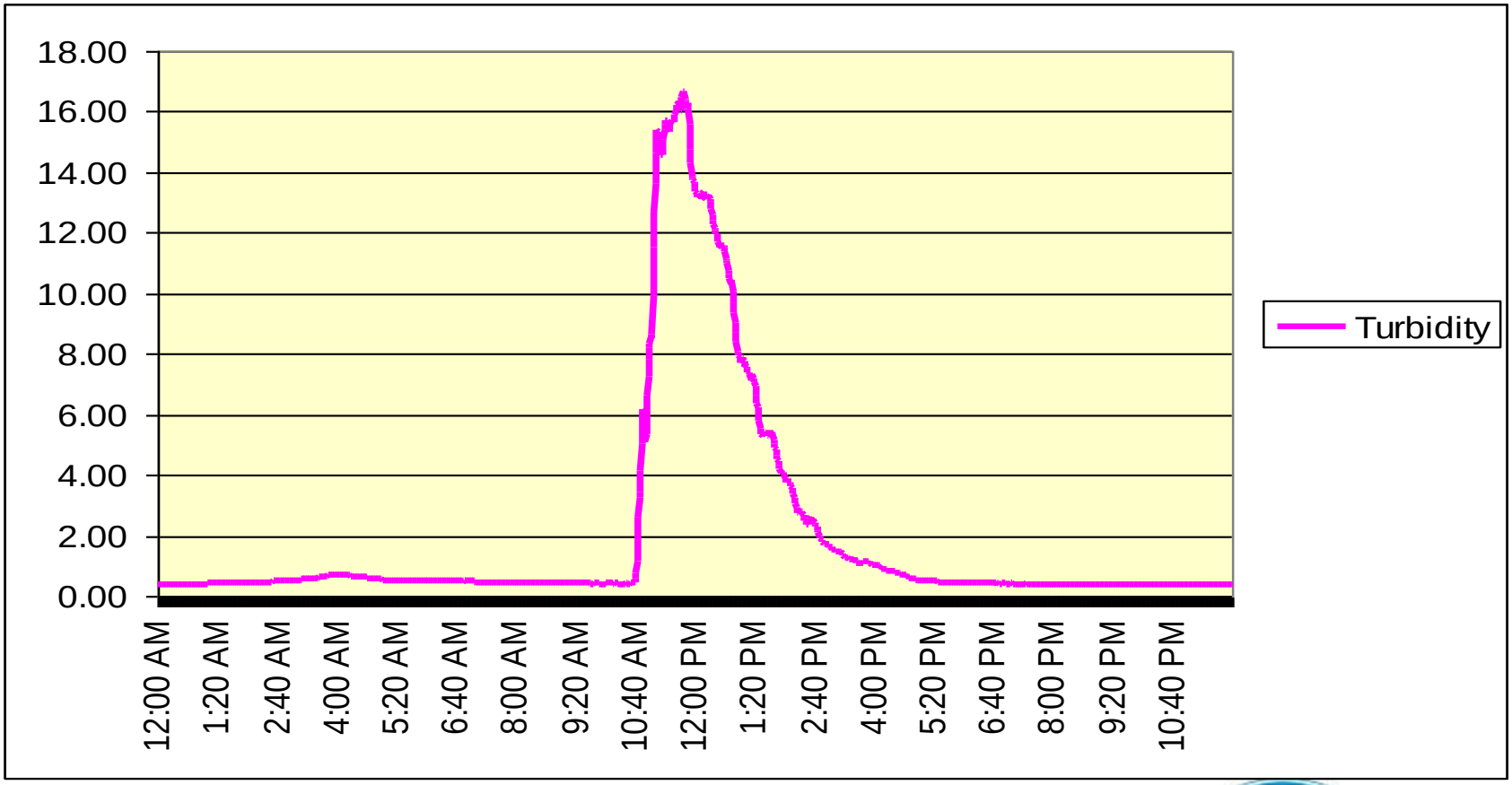
WORKERS MOVE A SECTION OF NEW PIPE INTO POSITION. THE BROKEN WATER MAIN CAN BE SEEN IN THE BACKGROUND.

TURBIDITY



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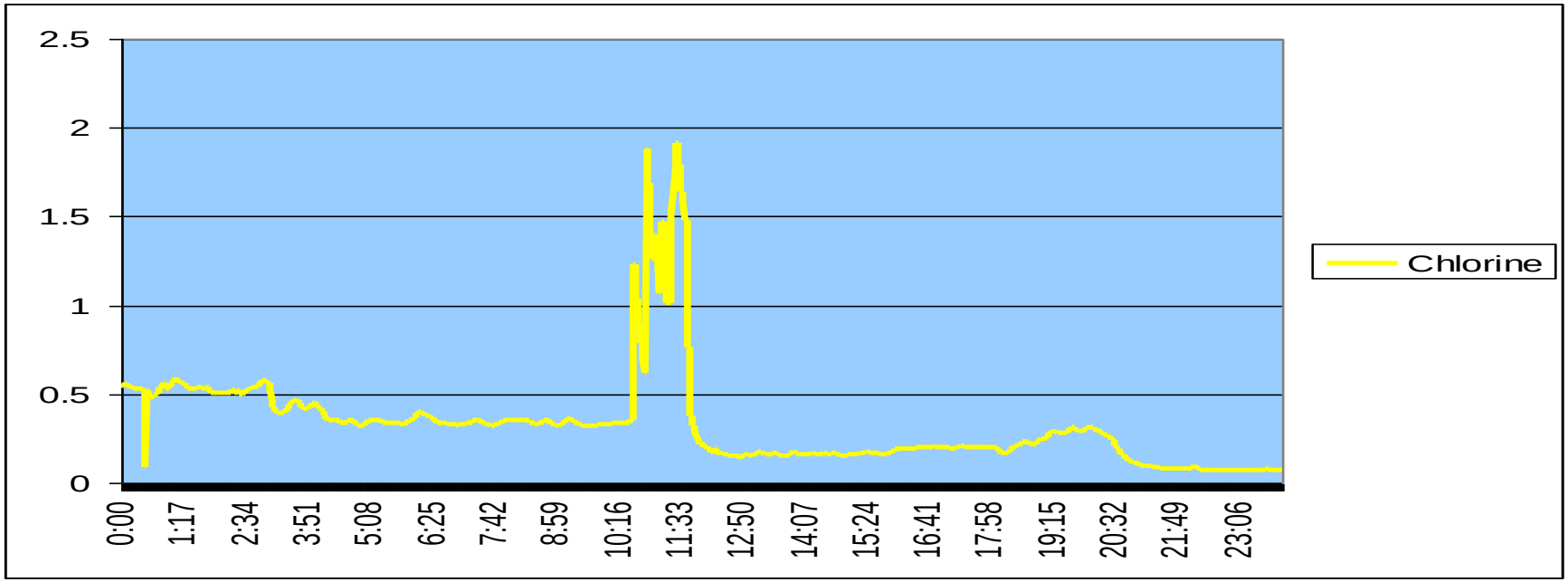
CHLORINE



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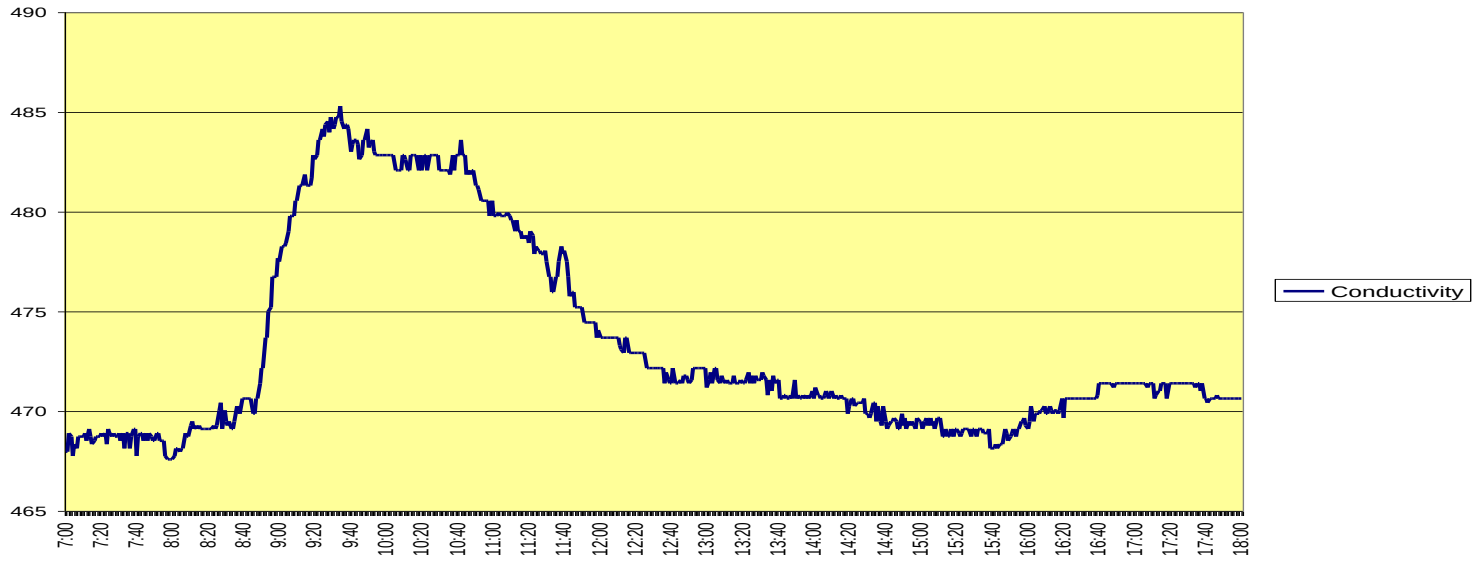
CONDUCTIVITY



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WHY WORRY ABOUT WATER IN THE DISTRIBUTION SYSTEM?

- Most water treatment facilities, operated correctly, can handle most events that occur in source waters.
- However, once the water leaves your facility, a number of different events can compromise the water quality in the distribution system.
- Water in the pipelines can become unsafe for consumption.
- May no longer be palatable to your customer.

WHY WORRY ?
WELL DOCUMENTED OUTBREAKS…

- Cabool, Mo., Dec. 1989- Jan. 1990
  - Line breaks and meter replacement
  - E. coli contamination
  - Pop. 2090
  - 240 ill, 6 deaths
- Gideon, Mo., Nov.-Dec. 1993
  - Poorly maintained water tank contaminated by birds
  - Salmonella contamination
  - Pop. 1100
  - 650 ill, 7 deaths

WELL DOCUMENTED OUTBREAKS…

- Milwaukee – 1993
  40,000 ill, 4,000 hospitalized, 50 deaths from cryptosporidium
- Walkerton, Ontario – 2000
  1,000 ill, 7 deaths from E.coli
- Atlanta – 1998
  24 ill, 2 deaths from E.coli at theme park

IN FACT, ….

- An estimated 2,038 Americans became ill from 17 outbreaks associated with drinking water during 1997–1998, according to the Centers for Disease Control

ENOUGH SAID…

- Distribution systems are important, but they can be complex, poorly understood, and often neglected.

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WHAT NEEDS TO BE KNOWN IN DISTRIBUTION SYSTEM MONITORING

- What does your distribution system consist of?
- What do we (should we) test for?
- Where do we test?
- How often do we test?
- How can we determine if something has happened in our system?
- How can we anticipate problems?

WHAT IS BEING TESTED TODAY?

- Frequent testing of:
  - Coliform bacteria, chlorine, possibly pH
- Infrequent testing of:
  - Lead and copper
  - Possibly pH, turbidity, temperature, alkalinity and hardness for corrosion control (lead and copper rule)

These are the minimum requirements

There is no magic bullet for assessing system integrity

TRENDING – DATA ACCUMULATION

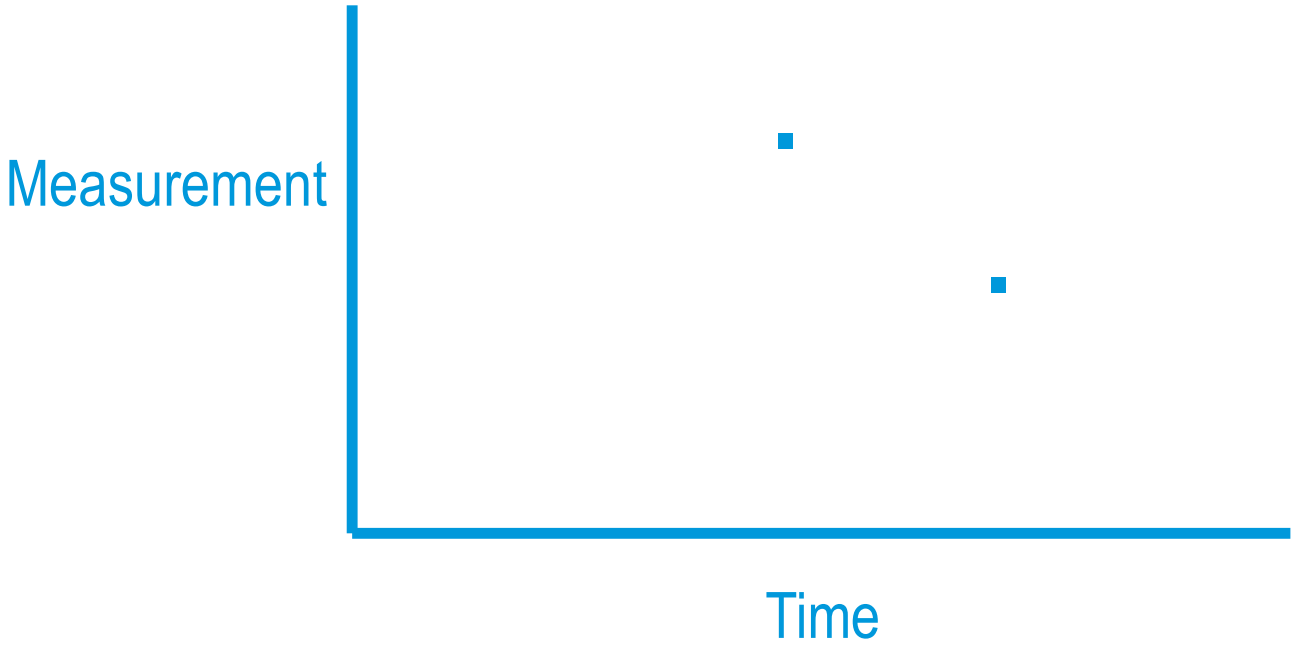
- Collecting baseline data is a crucial aspect of monitoring in the distribution system
- Need to collect enough reliable data to determine:
  - Normal variation
  - When a deviation has occurred
  - When the problem has been corrected

WHAT TESTS?

- A baseline must be established for standard tests values
  - pH, turbidity, conductivity, chlorine, fluoride, alkalinity, TOC
  - Nitrification, ATP
  - Auto Sampler for automatic sample collection

WHEN TO TEST?

- Look for trends



WHEN TO TEST?

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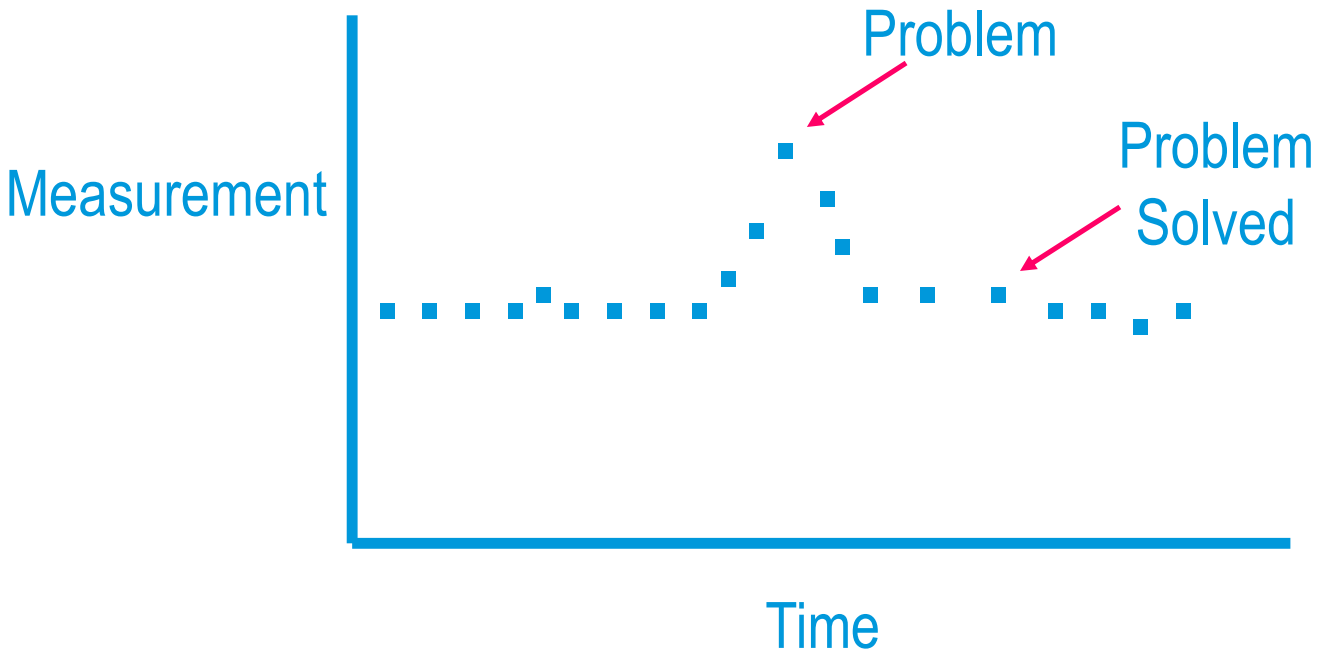

WHAT CAN YOU DO?

- Develop a monitoring plan to accumulate baseline data for trending
- Develop a written sampling plan to minimize sampling error and improve data quality
- Train samplers on proper sampling and analytical techniques

WHAT TESTS?

Tests are usually performed on grab samples.

Is there a problem with grab samples?

GRAB SAMPLE OR ON-LINE MONITORING?

- Many advantages to continuous monitoring
  - More reliable data and more of it!
  - Can be less expensive (labor, reagents, time)
  - Reduce sampling errors
  - “Real-time” data instead of historical

- More data (reliable) increases the chances of proper interpretation

WATER DISTRIBUTION MONITORING
A BASIC PLATFORM

- Total Chlorine
- pH
- Conductivity
- Turbidity
- Temperature
- Data output options for analog, digital, wireless

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WATER DISTRIBUTION MONITORING
AN ENHANCED PLATFORM

TOC – B3500DW

Fluoride

Automatic Sampler

Other depending on water source and quality

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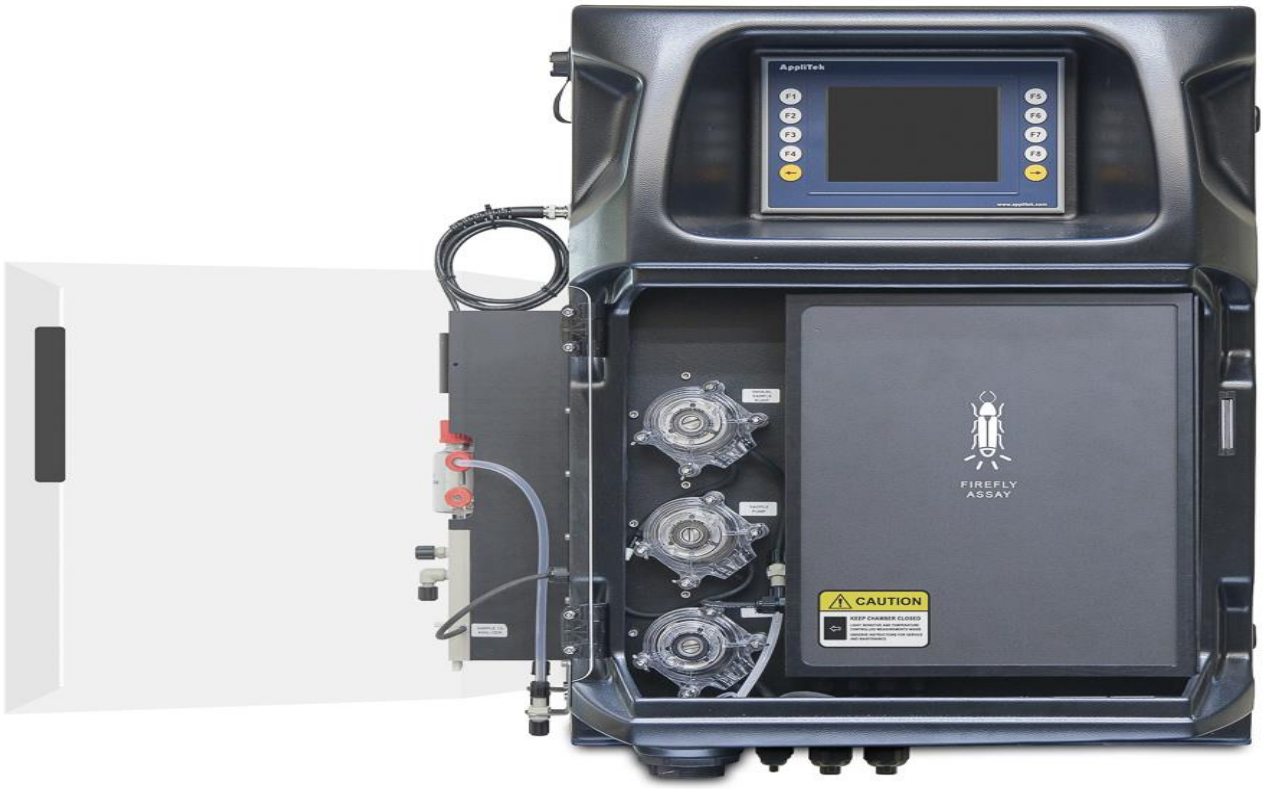
APPLITEK - EZ ATP



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WHY WORRY? –

- Not as much regulation
- Infrequent monitoring
- Many locations that are vulnerable

RISK ASSESSMENT

- Source
- Treatment
- Distribution

WHAT CAN YOU DO?

- Develop secure information sharing and analysis capabilities
- Improve knowledge of:
  - Contaminants, detection systems and treatment
  - Data acquisition and interpretation
  - Modeling

WHAT CAN YOU DO?

- Collaborate with others:
  - Federal agencies with water responsibilities
    - EPA, TVA, FEMA
  - State DEP and DOH
  - Water associations
    - State Rural Water Associations
  - Local governments

ROUTINE DISTRIBUTION SYSTEM FIELD MONITORING

- Test For:
  - Microbiological Quality
  - Turbidity
  - Disinfectant Residual
  - Lead and Copper
  - pH and Temperature
  - Alkalinity

DISTRIBUTION SYSTEM SAMPLING

Microbiological Quality

- Wash hands thoroughly
- Remove aerators and screens
- Clean questionable taps inside and out with bleach or germicide
- Run cold water for at least 2 to 3 minutes (can assume line is adequately flushed when constant temperature is reached)

DISTRIBUTION SYSTEM SAMPLING

Microbiological Quality (cont'd)

- Use sterilized container made of plastic or glass.
- Use dechlorinating agent (i.e., sodium thiosulfate) as necessary
- Fill container at moderate rate to avoid splashing
- Leave 1-inch air space for mixing sample
- Store in clean cooler at < 10 degrees C.
- Analyze as soon as possible, but do not exceed 30 hours hold time from collection to analysis

DISTRIBUTION SYSTEM SAMPLING

Disinfectant Residual

- Run cold water for at least 2 to 3 minutes (can assume pipe is flushed when constant water temperature is reached)
- Thoroughly rinse clean container made of plastic or glass (preferably glass) with cold water
- Slowly fill container by allowing water to run down side to minimize loss of chlorine to air.
- Analyze sample immediately

DISTRIBUTION SYSTEM SAMPLING

Lead and Copper

- Use a clean sample container (i.e., acid washed) made of plastic or glass.
- Do not rinse container if preservative has been added (i.e., nitric acid to reduce sample pH to < 2)
- Collect a first draw sample (i.e., stood motionless in plumbing system for at least 6 hours) from the cold water kitchen or bathroom tap.
- Analyze preserved samples within 6 months of collection

DISTRIBUTION SYSTEM SAMPLING

pH and Other Water Quality Testing Related to Corrosion Control

- Run cold water for at least 2 to 3 minutes (can assume pipe is flushed when constant water temperature is reached)
- For pH, thoroughly rinse clean container made of plastic or glass.
- Do not rinse the container if it contains preservative
- Slowly fill container by allowing water to run down side to avoid entraining carbon dioxide into sample

DISTRIBUTION SYSTEM SAMPLING

pH and Other Water Quality Testing Related to Corrosion Control (cont'd)

- Test for temperature immediately and pH within 15 minutes of collection
- Collect samples for laboratory analysis following procedures specified for individual parameter

PORTABLE KITS – FIELD TEST COLLECTION

pH, Conductivity, Chlorine

Easy Field Testing w/ up to 6 parameters at once.

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LUMINULTRA ATP TEST KIT

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HOW DOES THE ATP TEST KIT WORK?

- So what is ATP, anyways? It is the primary energy carrier for all forms of life – bacteria, algae, vegetable, animal cells – all of them contain ATP. Within any water sample, there will be two types of ATP:
- Intra-cellular (or just Cellular) ATP (cATP) – ATP contained within living biological cells. If desired, a conversion factor can be applied to approximate an equivalent microbial count*.
- Extra-cellular (or Dissolved) ATP (dATP) – ATP located outside of biological cells that have been released from dead or stressed organisms.
- The sum of these two types of ATP is referred to as Total ATP (tATP). The way that these types of ATP are isolated and measured depends on the application and thus the test protocol used.
- For applications such as drinking water, cooling towers, or oil & gas applications, Cellular ATP is measured directly by filtering the sample to separate and measure cATP on the filter, while the dATP passes through the filter and is not measured. cATP provides a direct indication of living biomass energy level, or in other words, total living biomass concentration.
- No matter what way you go about it, the end result is that within a couple of minutes of starting your test, you will have a true total measurement of all microorganisms contained in your sample.
- Having rapid information allows you to take action at the earliest possible moment, thus saving time and money.

WATER INFORMATION SOFTWARE

CLAROS – THE CLARITY OF WATER

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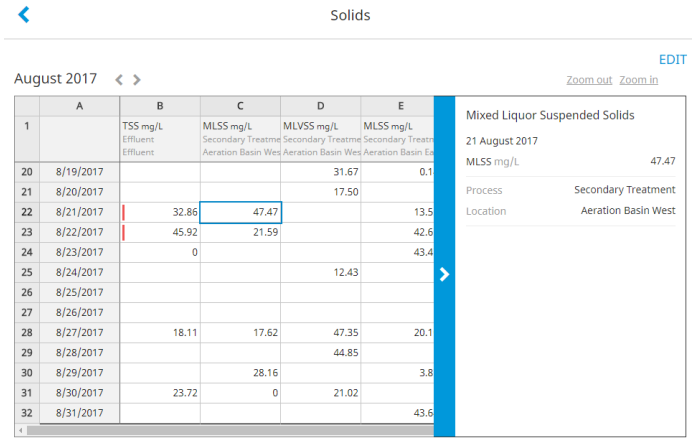
DATA MANAGEMENT – COLLECT

– Claros Collect offers spreadsheet and graph views from data collected. They are easy to configure and to present data in the most efficient way to identify insights.



Learn more: https://www.hach.com/claros-data-management

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SYSTEM COMPONENTS AVAILABLE TODAY

- Proven Analytical Instrumentation
  - On-line Water Distribution Monitoring Panel
  - On-line TOC
  - Automatic Sampler
- WIMS Software for Analyzing Data from Distribution Water Quality Monitoring
- Field Test Tools

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