Chemically Assisted Flushing in the Town of Gander

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Town of Gander

Gander

- The Town of Gander sits above Gander Lake in Central Newfoundland
- Population is 10,000
- 68.8 kilometres of distribution system
- 4000 services

Water Usage

- Use 359 cubic metres of water a day
- Began work in 2003 to construct a new Water Treatment Facility

New Water Treatment Plant

- Treatment plant utilizes sand, multi-media and carbon filtration
- Primary disinfection is obtained through ozone
- Secondary disinfection is obtained using chlorine

Water Treatment Plant

Water Treatment Plant

- A question arose about the cleanliness of the inside of the water lines in the distribution system and the reservoir

- Should the town address the issue of Bio-Film in the distribution system before the new treatment plant comes on-line? Council decided this was important.

Water Treatment Plant

- Reservoir was emptied and cleaned in September
- Chemically assisted flushing would be attempted later in the fall

Water Treatment Plant

Water Treatment Plant

What is Bio-Film?

Bio-Film

- No matter how efficient your treatment process some micro-organisms get into the water and possibly interact with the distribution system

- Bio-film is a slime that forms on the inside walls of pipes in the distribution system

Bio-Film

- According to the Water Distribution System Operation and Maintenance book used in this province;

- “a common example of Bio-Film is the black staining around the bottom of a shower curtain”

Bio-Film

- Bacteria in the water can become trapped in this Bio-Film and protected from your secondary disinfection
- The Free chlorine being used by most towns for secondary disinfection also gets used up attacking this Bio-Film

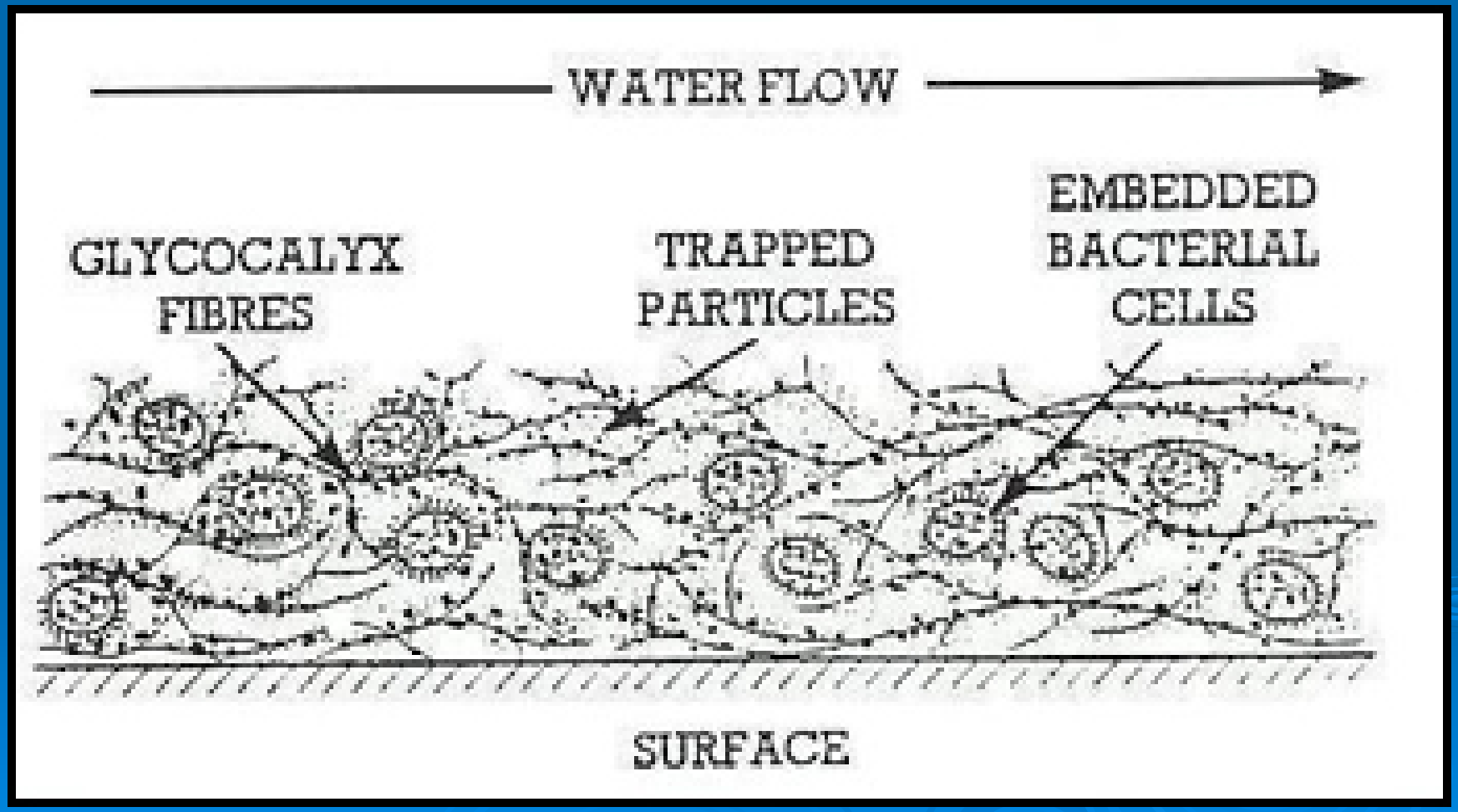
Bio-Film

- Free chlorine attacking the slime growth increases your chlorine demand
- Therefore, if you remove the some of the Bio-Film you should lower your chlorine demand
- This was the case in Gander

Bio-Film

- Anjou Technologies who make Bio-Purge have the following image on their website
  - It shows water flow through the pipe at the top
  - It shows the Bio-Film in the center with bacteria cells inside the slime
  - On the bottom it shows the wall of the pipe that the slime is attached to

Bio-Film


WATER FLOW
GLYCOCALYX FIBRES
TRAPPED PARTICLES
EMBEDDED BACTERIAL CELLS
SURFACE

Treatment Process

- Town of Gander discovered the process through a local citizen who knew of the company
- Anjou Technologies then contacted Gander
- Intent was to thoroughly clean distribution system before the treatment plant came online

Treatment Process

- Bio-Purge is a treatment that aids the removal of Bio-Film from pipe walls
- It is a type of citric acid treatment that attacks and loosens the slime that has formed on the pipe walls

Treatment Process

- Gander regularly flushes the system; however it is difficult to completely scour the inside of the pipes

- Loosening the slime before flushing makes it easier for removal of the Bio-film through flushing

Treatment Process

- Gander provided Anjou Technologies with their flow information and chemical test results
- Anjou determined the amounts of chemical needed and the chemical feed rates that would be necessary

Treatment Process

- The treatment process that Bio- Purge uses has;
  - Higher strength chemical called WD-3100 is used for cleaning the lines prior to flushing
  - Lower strength chemical called BD-2000 is injected to inhibit re-growth of Bio-Film in the system after flushing

Treatment Chemical

- WD-3100 & WD-2000 are certified ANSI/NSF Standard 60- Drinking Water Chemicals

- Both are recognized in the Canadian Food Inspection Agencies database under Water Treatment Compounds

Treatment Process

- Prior to beginning treatment the Town went to great lengths to inform the community using media such as newspaper announcements and public notices

Treatment Process

- Began treatment of the water with WD-3100 in November 2006
- It is dosed with a chemical feed pump just like any liquid chlorine system

Treatment Process

- Treated with WD-3100 for a few days prior to flushing
- Water was still safe to drink during the treatment process
- Water did develop a cloudiness during treatment due to Bio-Film breaking down

Treatment Process

- Chlorine demand did not rise during treatment because of a small amount of oxidant in the treatment chemicals
- Chlorine demand was reduced immediately after flushing was completed

Treatment Chemical

Handling Treatment Chemical

- According to the Material Safety Data Sheet provided with the chemical:
  - Treat chemical like an acid
  - Ventilate area being used
  - Use gloves, goggles when handling and a respirator if you feel the chemical may splash around

Flushing Process

- Flushing began after six days of treatment

Flushing Process

- Uni-directional Flushing continued for the next 12 days

Flushing Process

- Town uses plywood sheets to diffuse water flows to prevent erosion of ground around the hydrants

Flushing Process

- Water taken from hydrant during the flushing

Chlorine Demand Reduction

- Gander was using 40 pounds (18 kg) of chlorine per day to disinfect the water
- Immediately after the flushing were using 35 pounds (16 kg) of chlorine per day for disinfection

Post Flushing Maintenance

- This is not a one time fix
- Gander continues to perform maintenance like flushing to minimize the reformation of Bio-film
- Gander did not continue use of the BD-2000 for cost reasons (BD-2000 inhibits re-growth)

Disinfection By-Product Reduction

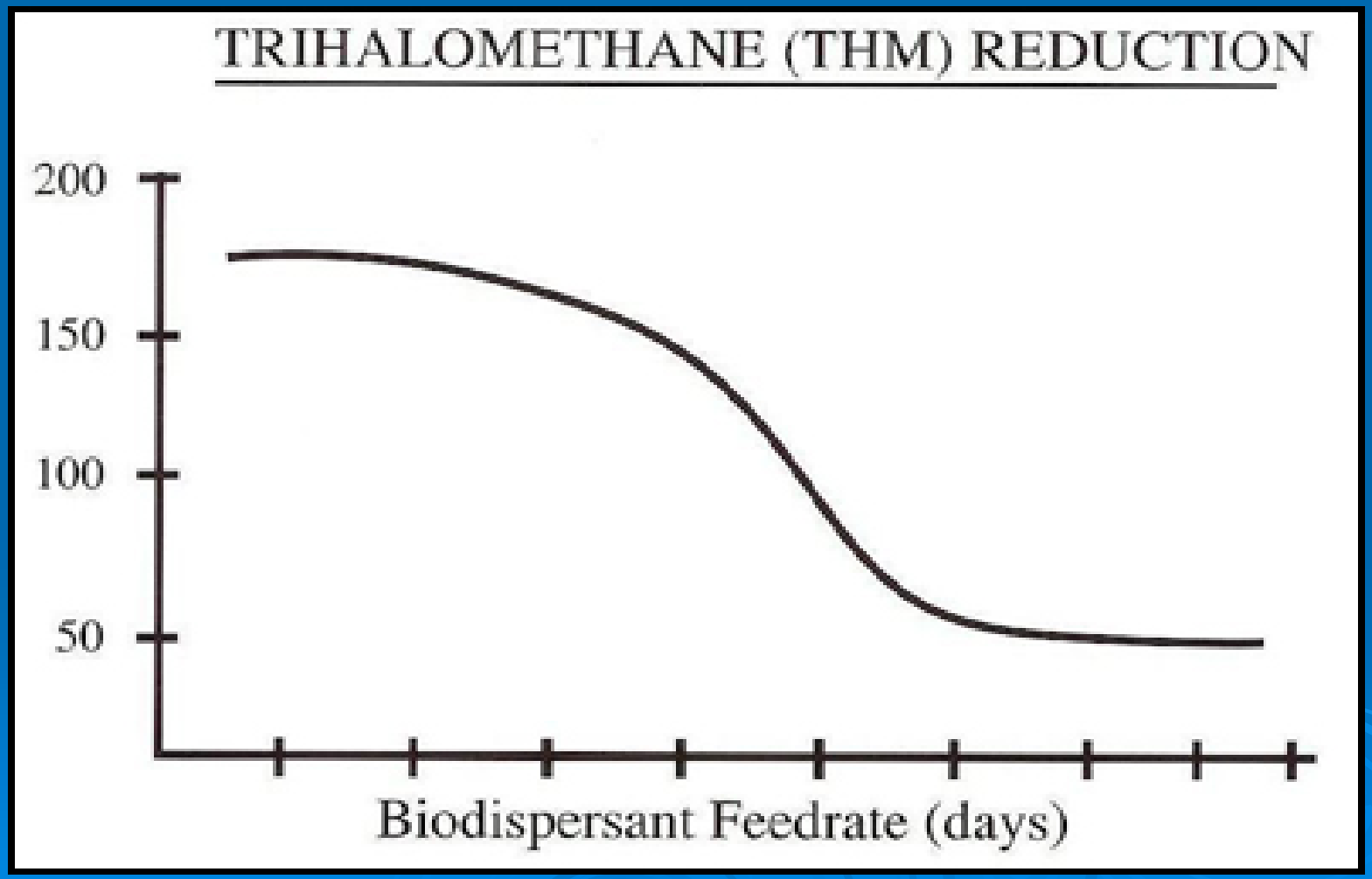
- THM's are a disinfection by-product
- By lowering chlorine demand in the system the town lowered the amount of chlorine being used to disinfect the water
- Lowering the amount of chlorine being put into the system lowered the potential for THM formation

Potential Reduction

- The following is not a graph of Gander's information, it is from the Bio-Purge website

- The THM Graph in the following slide depicts THM levels decreasing as the number of days using the Bio-Purge increases

THM Reduction



Alternative Treatments

- Shock Chlorination can also be effective against Bio-Film
  - This requires maintaining a chlorine residual in the range of 50-100 mg/L for a 24 hour period of time
  - The water cannot be used during this time
  - Obviously, this would require restricting public access to the water during this time
  - Disposal of highly chlorinated water also becomes an issue

Alternative Treatments

- Ozone and Chlorine Dioxide are both reported to be very effective for breaking down Bio-Film
  - Both processes require significant equipment upgrades
  - Both processes can be very expensive
  - Ozone does not leave a significant residual and it would be difficult to get an ozone residual throughout the distribution system

Alternative Treatments

- All of the treatments just mentioned are used in conjunction with a flushing program to physically remove the Bio-Film

Our Experience

- Gander's experience with Chemically Assisted Flushing was a good one to date

- It allowed the town to increase the benefits of the Uni-directional flushing that is done regularly

Our Experience

- Gander would use it again depending on the need assessed at the time
- Ganders water quality has improved significantly since the commissioning of the water treatment plant and the chemically assisted flushing was done

Our Experience

- There was feedback from citizens shortly after the flushing claiming they thought the treatment plant was already up and running

Other Local Experience

- According to our knowledge the Town of St. Lunaire –Griquet has also tried this process and were happy with their results

Questions?