

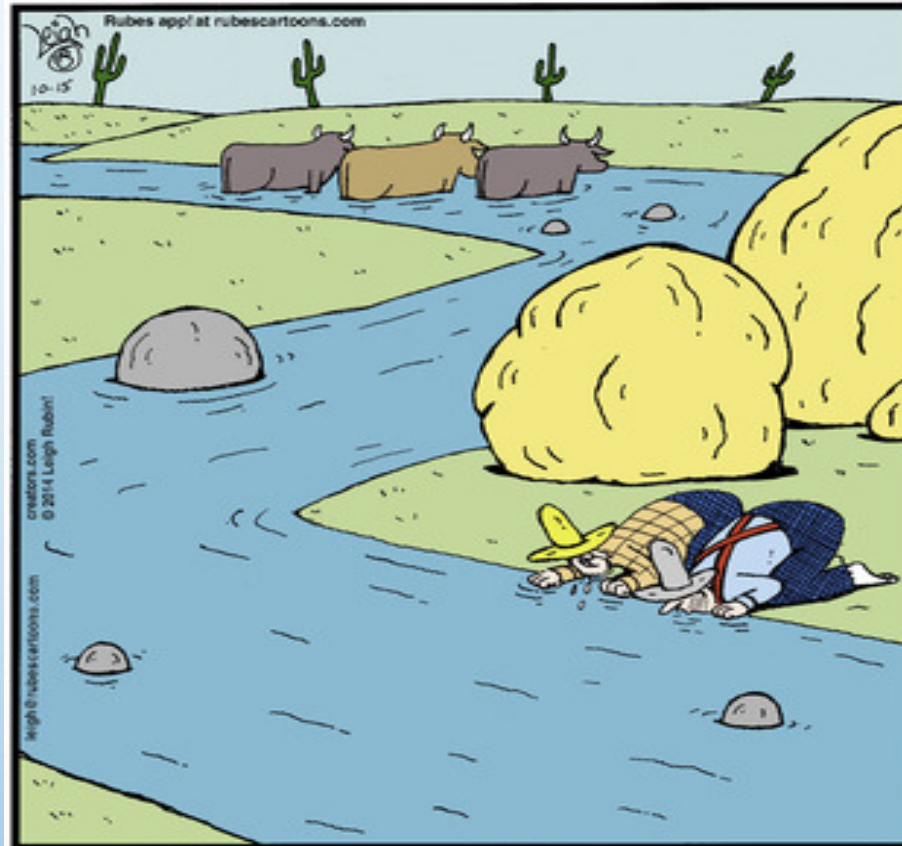
The background is a light blue gradient with several realistic water droplets of various sizes scattered across it. The droplets have highlights and shadows, giving them a three-dimensional appearance. They are located in the top-left, top-center, bottom-left, and bottom-right areas of the slide.

A TRIAL OF PAA AS AN EFFLUENT DISINFECTANT

DOUG KIMBLER

BOWLING GREEN MUNICIPAL UTILITIES

WHY WE DO WHAT WE DO



**"Ain't nothin' quite so refreshing as the
sweet taste of cool, clear, pure water,
eh, pard?"**



A LITTLE HISTORY

HISTORICALLY BGMU USED CHLORINE GAS AS ITS DISINFECTANT

WITH THE PLANT EXPANSION IN 1991-1993 CAME A NEW PERMIT REQUIRING DECHLORINATION.
BGMU CHOSE SODIUM META-BISULFITE.

THIS PROCESS WAS FOLLOWED UNTIL 2007.





A LITTLE HISTORY

IN 2007 BGMU BEGAN ITS REVIEW PROCESS FOR ITS NEXT EXPANSION AND RENOVATION.

AS BGMU ENTERED THE RENOVATION PROCESS, WE WERE INFORMED OF THE LIMITS THAT WOULD BE IN PLACE ON OUR NEXT KPDES PERMIT. WHILE THESE LIMITS WERE GENERALLY WITHIN THE CAPABILITIES OF THE EXISTING TREATMENT PLANT, A NEW SEASONAL LIMIT ON AMMONIA WOULD REQUIRE A NEW TREATMENT METHOD.

DUE TO SPACE CONSTRAINTS AT OUR PLANT SITE, BGMU OPTED TO GO WITH SBR TREATMENT.





A LITTLE HISTORY


AS PART OF THE EXPANSION PROCESS UTILITY EMPLOYEES DISCUSSED CHANGING TO AN ALTERNATE FORM OF DISINFECTANT FOR SAFETY.





HOW CHLORINE DISINFECTION WORKS


CHLORINE HAS BEEN THE STANDBY FOR TREATMENT PLANTS FOR OVER 100 YEARS. CHLORINE KILLS BACTERIA PRIMARILY BY ATTACKING THE CELL WALL, ALLOWING THE CELL TO LYSE. IT MAY ALSO DISRUPT ENZYMES WITHIN THE CELL NECESSARY FOR LIFE. ALTHOUGH IT IS LESS WELL UNDERSTOOD, CHLORINE APPEARS DISRUPT PROTEINS WITH THE VIRUS, INHIBITING THEIR ENTRY INTO A CELL.





HOW UV DISINFECTION WORKS

UV LIGHT ALSO HAS A LONG HISTORY IN CLEAN WATER TREATMENT. IT DISRUPTS THE DNA WITHIN A BACTERIA, PREVENTING IT FROM REPRODUCING. IT MAY ALSO DISRUPT THE NORMAL CELLULAR PROCESSES WITHIN THE BACTERIA. FOR VIRUSES, UV LIGHT ALSO DISRUPTS DNA OR RNA, PREVENTING REPRODUCTION OF THE ORGANISM.



PROS AND CONS

CHLORINE IS RELATIVELY CHEAP, EASY TO OBTAIN, AND EFFECTIVE. CARE MUST BE TAKEN WHEN HANDLING GASEOUS CHLORINE, AND IF LARGE ENOUGH QUANTITIES ARE ON SITE, A RISK MANAGEMENT PLAN MUST BE FILED WITH USEPA. HYPOCHLORITE MAY BE USED, BUT ON-SITE GENERATION REQUIRES A FAIRLY EXPENSIVE CAPITAL OUTLAY AND BULK STORAGE PRESENTS SAFETY ISSUES OF ITS OWN.

IN ADDITION, DECHLORINATION IS USUALLY REQUIRED UNDER NPDES PERMITS. THIS INCREASES THE COST BY HAVING TO PURCHASE ADDITIONAL TREATMENT CHEMICALS AND FEED EQUIPMENT.



PROS AND CONS

UV SYSTEMS ARE EASILY OBTAINED, REQUIRE NO CHEMICALS, AND NO RISK MANAGEMENT PLANS. THEY ARE MORE EXPENSIVE TO OPERATE, AND REQUIRE FREQUENT ROUTINE MAINTENANCE. IT DOES NOT REQUIRE ANY NEUTRALIZATION.





AND THE WINNER WAS...

A UV SYSTEM. BGMU WAS SET ON REMOVING GASEOUS CHLORINE FROM THE FACILITY, AND THE USE OF BULK BLEACH OR ON-SITE GENERATION WAS EVALUATED BUT DETERMINED TO NOT BE COST-EFFECTIVE.






UV DISINFECTION EXPERIENCE

THE UV DISINFECTION SYSTEM WAS DESIGNED BY GRESHAM SMITH AND PARTNERS, OUR ENGINEERING PARTNER FOR THE TREATMENT PLANT RENOVATION AND EXPANSION.

AS THE NEW PLANT WAS UNDER DESIGN, WE WERE UNABLE TO PULL TRUE SAMPLES OF PLANT EFFLUENT TO DETERMINE TREATABILITY. WITH THIS IN MIND, GS&P DESIGNED THE SYSTEM WITH 2 REDUNDANT TREATMENT CHANNELS (AND A THIRD FOR FUTURE USE) AND AN ANTICIPATED % TRANSMITTANCE OF UV AT 65%, MEETING ALL STANDARD DESIGN CRITERIA.



UV DISINFECTION EXPERIENCE

- UPON STARTUP THE UV SYSTEM WORKED WELL. BUT AS WITH ANY NEW SYSTEM, THERE WERE SOME WRINKLES TO WORK OUT.
- THE SYSTEM SHOULD HAVE “IDLED” AT 60% POWER USAGE; THE SURGES FROM OUR SBR’S REQUIRED US TO RUN AT HIGHER POWER OUTPUTS CONTINUALLY.
- THIS RESULTED IN LOWER LIFE SPANS FOR THE BULBS.

UV DISINFECTION EXPERIENCE

- WITH SHORTER LIFESPANS CAME MORE FREQUENT MAINTENANCE REQUIREMENTS INCLUDING REPLACEMENT OF QUARTZ SLEEVES THAT INEVITABLY BROKE AS WELL.
- WE WERE ABLE TO FIND LESS EXPENSIVE BULBS, BUT THESE CAME WITH THEIR OWN ISSUES INCREASING THE REPLACEMENT TIME AND MANPOWER.
- THE SELF-CLEANING MODULE ALSO DID NOT MEET OUR EXPECTATIONS.

UV DISINFECTION EXPERIENCE


- SO THE SYSTEM WAS MORE EXPENSIVE TO OPERATE, WITH A GREATER MANPOWER REQUIREMENT THAN EXPECTED.
- WE ALSO SAW ISSUES THROUGH OUR PLANT WATER SYSTEM DUE TO NOT HAVING A DISINFECTANT RESIDUAL IN THE SYSTEM.

UV DISINFECTION EXPERIENCE

- OCCASIONALLY WE SAW ISSUES WITH INADEQUATE DISINFECTION OF THE EFFLUENT. NOT ENOUGH TO CAUSE A PERMIT VIOLATION, BUT ENOUGH TO WARRANT INVESTIGATION ON WHY WE WERE HAVING REOCCURRING ISSUES.
- ANALYSIS OF OUR EFFLUENT OVER A 2 WEEK PERIOD SHOWED THAT THERE WERE SEVERAL DAYS WHERE THE % T WAS LOWER THAN 60%, EVEN WHEN THE WATER HAD NO VISIBLE IMPAIRMENT.



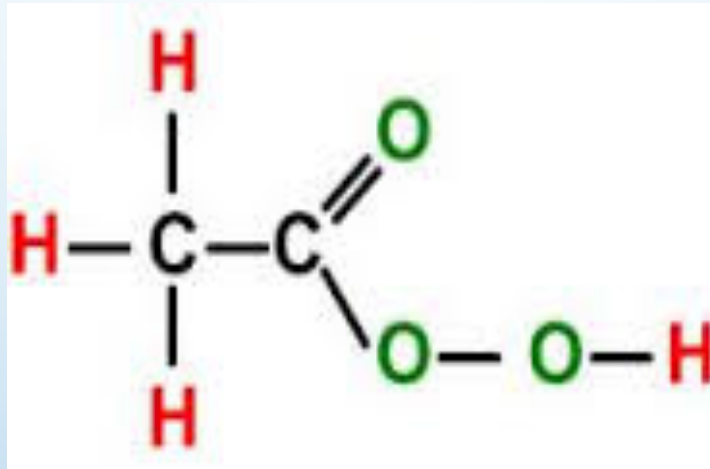
CLEAN WATER PROFESSIONALS IS A GREAT RESOURCE!

- AT THE 2014 CLEANWATER TECHNOLOGY SPECIALTY CONFERENCE (CONVENIENTLY HELD IN BOWLING GREEN KY), THERE WERE 2 PRESENTATIONS ON THE USE OF PAA AS A DISINFECTANT.
 - BGMU DECIDED TO PURSUE A TRIAL OF PAA.
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WHAT IS PAA

- PAA IS A STRONG OXIDIZING AGENT (SLIGHTLY LOWER IN OXIDATIVE CAPACITY THAN OZONE, BUT HIGHER THAN CHLORINE OR CHLORINE DIOXIDE).
- IT BREAKS DOWN INTO ACETIC ACID (VINEGAR), CARBON DIOXIDE AND WATER, DOES NOT FORM DISINFECTION BYPRODUCTS, AND DOES NOT NEED TO BE NEUTRALIZED.


WHAT IS PAA





HOW PAA DISINFECTION WORKS

PAA, OR PERACETIC ACID DOESN'T HAVE QUITE THE HISTORY IN THE UNITED STATES THAT CHLORINE OR UV DO, BUT IT HAS OVER 30 YEARS OF USE IN EUROPE. LIKE CHLORINE, PAA WORKS BY DISRUPTING THE CELL WALLS OF BACTERIA. IT ATTACKS THE NUCLEIC ACIDS OF VIRUSES, RENDERING THEM UNABLE TO REPRODUCE WITHIN AN INFECTED CELL.




PROS AND CONS

PAA IS EASY TO FEED, UTILIZING METERING PUMPS, AND HAS A GOOD KILL RATE. IT IS RELATIVELY EXPENSIVE ON A PER POUND BASIS ALTHOUGH THE COST IS CURRENTLY DECREASING AS MORE FACILITIES MOVE TO IT AND NEW PRODUCTION FACILITIES COME ON-LINE. IT DOES NOT REQUIRE ANY NEUTRALIZATION.



A TIP OF THE HAT

THROUGHOUT THIS TRIAL PROCESS, BGMU STAYED IN CONTACT WITH THE LOCAL KYDOW OFFICE AS WELL AS FRANKFORT. JORY BECKER AND BILL BAKER WERE OPEN TO THE POSSIBILITIES OF A NEW DISINFECTANT AND ONLY ASKED THAT WE MAINTAIN THE UV SYSTEM IN CASE WE NEEDED TO SWITCH BACK.



INITIAL TRIAL – MAY 2015

- FIRST WE NEEDED TO DETERMINE A SOURCE OF MATERIAL.
- WE WORKED WITH OUR SUPPLIER PEROXYCHEM, WHO PROVIDED 15% PAA IN TOTES, ALONG WITH A SKID MOUNTED FEED SYSTEM.
- WE LOCATED AN OPTIMAL FEED POINT JUST PRIOR TO OUR UV SYSTEM.

INITIAL TRIAL – MAY 2015

- LAB SCALE TESTING INDICATED THAT WE SHOULD ACHIEVE GOOD DISINFECTION LEVELS WITH A 1.25PPM FEED RATE. WE DECIDED TO START AT A HIGHER DOSAGE.
- THIS WAS A GOOD PLAN AS OUR INITIAL FEED NEEDED TO BE AT 2.0PPM FOR ADEQUATE DISINFECTION.
- WHY? WE QUICKLY SAW THE IMPACT OF HAVING A RESIDUAL IN OUR PLANT WATER SYSTEM, WITH A SLOUGH OF BIOFILM HAPPENING FOR AN EXTENDED PERIOD.

PAA TRIAL PACKAGE



PAA TRIAL PACKAGE



INITIAL TRIAL – MAY 2015

- THE INITIAL TRIAL WAS PROMISING, EVEN THOUGH OUR DOSAGE RATE WAS HIGHER THAN EXPECTED. WAS THIS DUE TO THE BIOFILM THAT WAS PRESENT, OR WOULD THIS END UP BEING THE TRUE DOSAGE RATE? WOULD WE SEE A DIFFERENCE OVER TIME, OR WITH CHANGING TEMPERATURES?
- WE DECIDED TO DO A SECOND TRIAL. AGAIN JORY BECKER WAS VERY ACCOMMODATING IN GRANTING A WAIVER FOR THE TRIAL.

SECOND TRIAL – FALL 2015

- OUR SECOND TRIAL WAS CONDUCTED IN THE FALL OF 2015. WE SAW A GREATLY REDUCED DOSAGE RATE. WE WERE ABLE TO CONTINUALLY REDUCE OUR FEED RATE UNTIL WE WERE UNDER 1.25PPM.
- THIS RATE WAS IMPORTANT AS IT REPRESENTED THE BREAK-EVEN POINT WHERE FEEDING PAA WAS CHEAPER THAN UTILIZING THE UV SYSTEM, INCLUDING DEBT SERVICE ON THE SYSTEM.

SO WHAT'S THE PLAN?

- WITH THE TRIALS SHOWING THAT THE MATERIAL BOTH WORKED WELL AND COULD BE COST EFFECTIVE, WE APPROACHED KYDOW ABOUT ALTERING OUR PERMIT TO MAKE PAA THE PREFERRED DISINFECTANT. AGAIN, WE HAD NO ISSUES WHATSOEVER FROM A REGULATORY STANDPOINT.
- AND WITH THE PERMIT EDITED, WE HAD A DECISION TO MAKE. DO WE CONTINUE ON WITH:
 - A TOTE SYSTEM AND A SUPPLIED PUMP SKID
 - A TOTE SYSTEM WITH OUR OWN PUMPS
 - BULK STORAGE

SO WHAT'S THE PLAN?

- WE FELT LIKE A BULK SYSTEM WOULD ALLOW A PRICE BREAK ON MATERIAL WHILE REMOVING SOME SAFETY AND STORAGE CONCERNS INVOLVED WITH TOTES. ON THE OTHER HAND, THIS WOULD REQUIRE A LARGER CAPITAL OUTLAY INITIALLY.
- AFTER DRAWING IN INPUT FROM OUR OPERATIONS STAFF AND OUR ENGINEERING STAFF WE DECIDED TO MOVE FORWARD WITH BULK STORAGE.

SO WHAT'S THE PLAN?

- INTERNALLY OUR STAFF PROJECT MANAGER SCOTT NEIGHBORS BEGAN DESIGN AND CONSTRUCTION ON THE BULK STORAGE SYSTEM WHILE WE PROCURED BIDS ON THE MATERIAL.
- THE BULK FEED SYSTEM INCLUDING A 5,000 GALLON STORAGE TANK AND REDUNDANT PUMPS ALONG WITH CONTAINMENT AND SAFETY EQUIPMENT. THESE ITEMS WERE PROCURED AND INSTALLED FOR ABOUT \$130,000.
- WHEN WE OPENED BIDS WE SAW THE PRICE FOR BULK DROP OUR COST BY \$0.25/LB OVER THE COST PER POUND IN TOTES. THE BULK SYSTEM PAYBACK ENDED UP BEING ABOUT 18 MONTHS, WELL WITHIN OUR ESTIMATE.



AND WHAT DOES THE NEW SYSTEM LOOK LIKE?

THE NEXT SLIDES SHOW WHAT A COMPACT BULK STORAGE SYSTEM LOOKS LIKE ON SITE.



PUMP SKID



SETTING THE FEED RATE



BULK TANK AND FILL CONTROL PANEL




THINGS YOU DON'T THINK ABOUT





LESSONS LEARNED

- DON'T BE AFRAID TO TRY NEW THINGS
 - DON'T BE AFRAID TO ASK FOR HELP
 - THE LITTLE THINGS COUNT FOR A LOT
 - WHEN YOU GO, ONLY GO BIG IF YOU NEED TO
 - DETENTION TIME IS HUGE
 - THE MARKET IS SWINGING IN YOUR FAVOR
- 

#WENEVERCLOSE (TAKEN PRIOR TO SOCIAL DISTANCING RULES)



QUESTIONS?