BACTERIA AND SUGAR LOSS CONTROL IN A NON-FORMALDEHYDE ERA

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Introduction

As everyone knows the last few years there has been a greater emphasis on protecting the environment in which we live and work. Technology has evolved to the point that we are capable of detecting very small concentrations of hazardous substances. This technology also gives the regulatory people a greater ability to monitor the effects of certain chemicals on workers and the products we produce. As a result much tighter environmental and FDA laws can be written and enforced to protect employees, the public, the environment, and products produced.

For years formaldehyde was the chemical of choice for bacterial control around the diffusion process in the sugar industry. It is now thought that it can be harmful to people if they are exposed to very low concentrations of this chemical. Although not completely banned for use in the sugar industry, it's use is heavily regulated by State and Federal laws. Therefore, industry started looking for a replacement for formaldehyde that would be as effective without detrimental effects to the process and do it at a reasonable cost.

Discussion

During the campaigns of 1988 through 1990, Mike Fowers along with the assistance of factory personnel from our Nampa, Idaho and Nyssa, Oregon factories, evaluated a number of microbiocides as to their effectiveness and to their effects on the process and equipment. Along with formaldehyde, chlorine dioxide, liquid sulfur dioxide, and ammonium bisulfite were studied. Each was evaluated as to it's effectiveness as a biocide.

The effectiveness of the biocides used alone and in conjunction with formaldehyde were determined by gathering samples and plating them out. After incubating for 72 hours, the colonies were counted and documented. From this work, information was gathered as to what would work as a good replacement for formaldehyde along with the advantages and disadvantages of each biocide.

Part of the study done by Mike Fowers included testing ammonium bisulfite on BMA diffusers at the Nampa factory. These diffusers are very similar in size to the diffuser at Twin Falls. From this study the people at the Twin Falls factory had tentatively decided on using ammonium bisulfite (ABS) as the replacement for formaldehyde. The ABS seemed to be as effective as the liquid sulfur dioxide, which was tested at the Nyssa factory. It didn't seem to have some of the corrosive problems and the safety concerns that must be dealt with when dealing with liquid sulfur dioxide.

It wasn't until the summer of '92 when representatives from each of the four factories met and committed to completely eliminate formaldehyde. The advantages and disadvantages of each biocide were discussed during the meeting. Discussions also included the safety and environmental concerns of each biocide. At the end of the meeting each factory was committed to eliminate formaldehyde and use either ABS or sulfur dioxide.

Since we were committed to using ammonium bisulfite (ABS), which we had never used in our system before, we had to look at what type of changes needed to be made to our existing system to get it to work. We also had to determine at what points in the process to apply the ABS. The decision was made to inject the ABS at the same points in the process that formaldehyde used to be. These points included all of the areas as those mentioned in the study, plus some additional ones. The existing biocide pumps that were in use had the metallurgy to handle ABS. It left only the piping to change out to have a functioning system. The existing carbon steel piping was replaced with 316 stainless steel pipe to prevent potential corrosion problems.

Since the use of ABS was new to the operation there were some concerns about it's use and its effect on equipment. The biggest concern was how corrosive the material was going to be on the equipment. Most of the equipment is made of carbon steel, so in many cases once the chemical left the distribution piping it was in direct contact with this material. These concerns seem to have been justified because of some apparent corrosion around the pressed pulp juice screens in the dryer and the press return heaters where there were some shell and tube sheet failures. The failures in both areas appear to be corrosion related. It will be after the beet slice is over before an attempt is made to determine what caused the failures.

The second major concern was the additional ammonia that is added to the process. The majority of the ammonia is removed in carbonation, but the ammonia that isn't removed is usually vented to the atmosphere in the evaporators or it ends up in the condensate. Ammonia in condensate can be a problem depending on where the condensate is used in the factory. If it is excess condensate and is sent out as waste water, it will add to the COD of that water. In the case of the Twin Falls factory it adds to the loading on the waste water farm if not brought down by aeration.

Ammonia is a Form R chemical. As such, quantities released to the atmosphere must be reported to the EPA. ABS added to the process increases the ammonia release to the atmosphere, increasing factory reportable levels. Any increase in discharge levels is not desired from a pollution standpoint.

At the time of beet slice it was estimated that it would take approximately 400 to 500 gallons per day ABS to control the bacteria. This estimate was derived from the information gathered from the testing done at the Nampa factory. It was also known that early in a typical campaign there is normally very little bacterial activity that justified using formaldehyde except in the tailings and press return flow loops. It was decided that at the start of the campaign ABS would be added to the tailings loop knowing that some would carry through to the press return water because of the way the systems are tied together. The process people were then instructed to monitor the lactic acid levels in the raw juice and compare those with the lactic acid levels associated with the incoming beets. If there was a rise of approximately 100 ppm lactic in the raw juice they would shock treat different points on the tower and mixer with approximately 25 gallons of ABS over a period of 10 minutes.

About the third week of the campaign the decision was made to elevate the temperature profile in the diffuser and mixer. Operators were instructed to bring the mixer and mid tower temperatures up as high as possible without adversely affecting the ability to press the pulp. Over a 5 day period the temperatures were slowly brought up an average of 3 to 3.5 degrees C across the system. Since temperature is one of the best ways to control microorganisms in this environment, this one decision has had the greatest impact on the amount of losses due to microbial activity.

About the same time as the temperature increase in the diffuser, juice samples were taken to profile the microorganism activity across the beet end. The samples were taken and plated twice a week. After a 72 hour incubation period the colonies were counted. This information was gathered to show where and if there were any major infections taking place.

There was also an attempt to locate any specific area in the process that would indicate where the majority of our losses were taking place. For approximately 40 days the factory chemist ran a lactic acid profile daily across the diffuser. The profile consisted of four points, top of tower, mid tower, bottom of tower, and press return water before the heater. From the data the chemist plotted the unaccountable losses to the lactic acid levels and found that the press return lactic gave the best correlation. This could be expected because it is general knowledge that the presses and press return system is an environment in which microorganisms will flourish.

Conclusions

It was found through this campaign that sugar losses could be kept under control without the use of formaldehyde. By paying close attention to operating parameters and knowing what to watch for, temperatures were increased to a point that the microbial activity was slowed down thus keeping losses down.

One thing that does need to be mentioned is the fact that the BMA diffuser at Twin Falls is rated by BMA at 4500 TPD slice and it was run at an average slice of 6500 TPD this campaign. As a result the amount of time the cossettes are at elevated temperatures is somewhat less than if the throughput was at the diffuser rating. This could be why there was no detectable problems with the condition of the pulp going to the presses. Elevated temperatures were tried at other Amalgamated factories that have daily slice rates closer to the design slice rates of their diffusers with poor results. They had problems with high pressed pulp moisture.

By comparing this campaign with the last two campaigns, there hasn't been any detrimental effects showing up in the areas that would be affected from the changes made to the process.

	1991	1992	1993
SLICE - AVG / DAY	6356	6163	6500
DRAFT	125	124	124
UNKNOWN LOSS - % ON BEETS	0.36	0.30	0.36
PULP % MOISTURE	74.3	73.6	74.6
PULP LOSS - % ON BEETS	0.32	0.33	0.34
FUEL TO DRYER THERMS/TON	55.5	59.7	58.7
BIOCIDE GAL/KTON BEETS	30.9	61.7	6.3

There has been a lot of information gathered this campaign which will be used next year when attempts are made to improve on the losses due to bacteria.