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Controlling of Odour Issues in Packaging Industries



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Abstract

Since the demand & awareness to save the environment hasincreased significantly, not only in India but in global Paper Makers,which tends to make the paper with keeping the Water Circuits as close as possible.

Problems started from the here to recover more fiber & to maintain water quality as good as possible. At present we have numerous technologies to improve water quality.

So many times, we observe bad or a foul smell/Odor while passing through certain Paper Mills and its more so in the case of recycled mills producing packaging grades.

Are there any techniques to resolve the issue or no?

Using the same water continuously or high levels of recirculation will cause the Odour Issues especially for Kraft Mills where we have to survive with recycled furnishes.

Introduction

A main purpose of food packaging is to protect and conserve the food's flavor and smell. If the packaging material itself has any smell/odor, there will be a significant risk of unacceptable smell/odor interactions. Odorous compounds from the packaging material may be transferred to the food and affect the food's flavour. Considerable losses may be experienced when such transfer of chemicals results in consumer dissatisfaction. The problem with odour and taste is complicated by the lack of simple and easy-to-use assessment methods. Further complications are caused by the fact that the Odor often changes during paper storage. The odor experienced by the consumers may thus differ from the odor detected by the mill quality control systems. For paper and board used for packaging, there are several potential sources for odor interactions. Paper and board will never be completely odorless, and their odorous compounds are known to taint foods. The odorous compounds in paper may originate from quite different sources.

In mills with closed water system or in mills using recycled pulp, microbiological activity is frequently the main source for odour.

Oxidation of wood extractives is the most important odour source in furnishes containing mechanical pulp or sulphite pulp.

Paper additives and degradation of paper additives are also reported as sources for odour.

Whereis the problem?

Most of all the grades of paper can have a problem with odour.

Odor can be a part of the paper or as a part of the operations. All odors are noxious or toxic in nature. This problem is more with Kraft Based Mills as compared to other grades. If we look at Indian Kraft or Packing Industry, almost whole industry is 100% recycled. In our Kraft Grade Making Process, we are using waste paper and most of the waste paper is unbleached and having more waxes, gums and volatile extractives. Due to close loop system we are just recirculating the back water in the system and increasing the COD & BOD load which lower the dissolved oxygen (DO) values. With old corrugated container (OCC) we have an N Number of identifyingsources of the odor.

The Major factor effecting the odor to our product quality are as below:

Factors affecting paper odour		
Process	Possible effects	Odor Response
Bleaching	Alkaline stages remove extractives Chelating agents remove metal ions Oxidative chemicals initiate rancidity	Overall Odour Reduction
AKD Sizing	AKD sizing increases pH.	Increased odor
BioCide	Decreased Microbiological Activities	Decreased Odor
Washing	Fines & extractives are removed	Decreased Odor
Recycled Paper	Spores & bacteria are fed to the system	Increased odor
Coating Latexes	Contaminated by Volatile monomers	Increased odor

- Wood extractives are the dominating sources for odour in paper grades containing mechanical pulps or sulphite pulps.
- The problems are especially severe for unbleached pulps because of the higher extractive and metal ion content.
- Fats and waxes constitute a major fraction of the wood extractives. There are also some free fatty acids in wood.
- The amount of fats, waxes and free fatty acids in wood vary depending on many factors like wood species, season, place of growth, weather condition and others.

- In general, quite large variations are observed. Some of the fatty acids are unsaturated and these fatty acid reacts and forms many odorous & volatile compounds are formed.
- Close water loop tends to increase the Microbiological load & creates the odor issue.
- Starch like wet end or dry end tends to increase the microbiological actives and lead the odor issue even after cooking it at higher temperature.

Cause of Odour

We can differentiate the cause of odour problem in two main groups:

1. Chemical
2. Microbiological

The Microbiologically caused problems occurs more often than the chemical ones&MB activities are the major reason of odour issues in packaging grades.

For investigating an odor problem, we need to understand the possible causes. There are various lab test methods available in the market to identify the odour forming gas, but the question is are theseresources easily available or are they cost effective or are we capable to handle such expensive equipment with low margin productivity.

To make it more simple & cost effective the best tools are as below:

TBC (Total Bacteria Count)	–	Total Aerobic Counts
SRB (Sulphate Reducing Bacteria)	–	Anaerobic Bacteria
ORP (Oxidation Reduction Potential)	–	Oxidizing or Reductive
DO (Dissolved Oxygen)	–	Oxygen in the system
VFA (Volatile Fatty Acid)	–	System VFA

All above testings are easy to perform & all are cost effective.

We are focusing on VFAs as there is limit information on VFAs.

VOLATILE FATTY ACIDS

What are VFAs and where do they come from?

VFAs are fatty acids with an aliphatic tail of less than six carbon atoms. Table 1 lists the various VFAs and the odour they produce.

Common Name	Systematic Name	Odour
Formic acid	Methanoic acid	Pungent solvent like nail polish
Acetic acid	Ethanoic acid	Vinegar
Propionic acid	Propionic acid	Body odour
Butyric acid	Butanoic acid	Rancid butter, vomit
Isobutyric	2-Methylpropanoic acid	Rancid butter
Valeric	Pentanoic acid	Fruit like
Isovaleric	3-Methylbutanoic acid	Body odour

Table 1. *Volatile Fatty Acids*

The most common types of VFAs found in recycled packaging operations would be acetic, propionic and butyric. Many different types of bacteria can produce VFAs; these include both facultative and strict anaerobic bacteria. Facultative anaerobic bacteria can survive with or without oxygen while strict anaerobes thrive in no or low oxygen conditions.

One example of a VFA producing bacteria is the Clostridium genus. These are obligate anaerobes, meaning that oxygen is toxic to them. They are also endospore formers. Some bacteria form an endospore; this is a spore that is formed inside the bacterial cell that contains the genetic material. This spore is released when the cell dies and is very resistant to hostile environmental conditions. They will survive prolonged boiling for example. Once conditions are again favorable to the bacteria`s growth, the spores wake up and start to grow. The presence of endospore forming bacteria is a factor that needs to be considered in a control program.

What are the issues that can be caused by VFAs?

These fall into a few areas; the first is odour, which can be in the final product or in an area it is stored. There can be complaints from neighbors or from the workers in the mill. Odour in the final product can be a very serious issue that can lead to loss of business and can put a mill`s future in jeopardy. Some packaging customers have limits on the VFA level in the sheet that need to be met by the board producer.

Under anaerobic conditions many microorganisms will produce volatile fatty acids (VFA), which are smelly substances. Acetic acid (vinegar odour), butyric acid (rancid butter odour), propionic acid (Swiss cheese odour) and valeric acid are the predominant VFAs. In addition to VFAs, sulphur reducing bacteria can produce hydrogen sulphide (H2S), with a smell like rotten eggs.

In a paper mill, the water flow is constantly changing between direct aeration and stagnation in storage tanks. Web/Paper/Sheet breaks introduce dynamic disturbances to the water system. The paper machine water system will thus tend to favour the growth of facultative anaerobic organisms, and inhibit the growth of strict anaerobic microorganisms. The consequence will be that, in closed water systems, the VFA concentration builds up in the process water, finally ending up in the products.

HOW TO REDUCE ODOUR CAUSED BY MICROBIAL ACTIVITY

Purpose is to avoid VFS’s being formed. VFA’s are formed only under anaerobic conditions, hence to avoid its production following actions should be ensured:

- Adequate oxygen concentration in the system.
- Good water circulation.
- Direct aeration.
- Avoiding stagnant water
- **Suitable biocide to avoid build-up of microorganisms.**
- **Exact biochemistry to reduce VFA’s concentration in system (DMH).**

Lab Test Results:

All the testings were conducted in our Lab with Kraft Mill Pulp. To simulate the results pulp was taken from the Mill & diluted with Process Water. (Table. 2 list the results)

Product	ORP (mV)	FRC (ppm)	TCL (ppm)	TBC (cfu/ml)	SRB	VFA (ppm)
Blank	-115	0	0	2.80E+07	1.00E+06	15861
DBNPA (50 ppm)	-110	0	0	8.00E+06	1.00E+05	15197
QUAT (50 ppm)	-102	0	0	1.10E+07	1.00E+06	15534
ISO (50 ppm)	-112	0	0	1.20E+07	1.00E+06	15186
GLUT (50 ppm)	-105	0	0	1.00E+06	1.00E+04	14862
DMH (150 ppm) + Hypo	75	1.5	0.4	3.20E+05	1.00E+03	13256
BROMIDE (250 ppm) + Hypo	32	0.8	0.2	1.00E+07	1.00E+05	15087
Ammonium Sulphate (250 ppm) + Hypo	74	1.45	0.5	4.30E+05	1.00E+03	13568
Hypo (1500 ppm)	20	0.5	0.8	2.40E+06	1.00E+05	15321

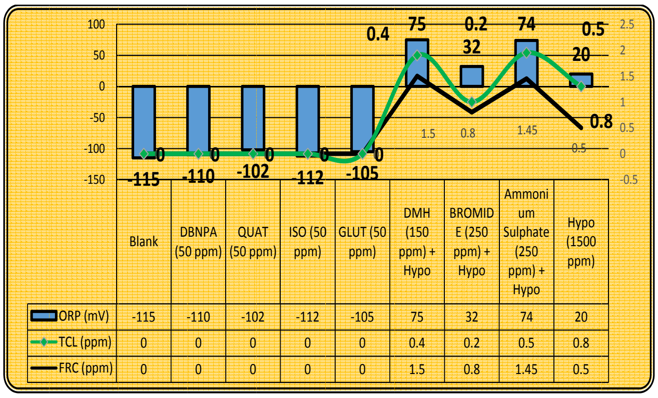
Table - 2

We have applied the standard dosage for toxicant studies which we normally recommended for any program.

Results:

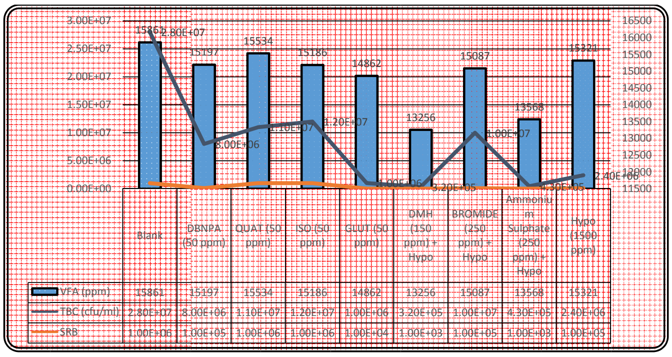
Figure 1. & Figure 2. It's self-elaborate the impact of DMH, Ammonium Sulphate & Glut, in terms of reduction in overall parameters.

Significant reduction has been observed in TBC & VFA. Improvement in ORP Values hence the stable TCL & FRC. With Bromination we could able to get some positive values in ORP but there is no significant reduction on VFA.



	Blank	DBNPA (50 ppm)	QUAT (50 ppm)	ISO (50 ppm)	GLUT (50 ppm)	DMH (150 ppm) + Hypo	BROMIDE (250 ppm) + Hypo	Ammonium Sulphate (250 ppm) + Hypo	Hypo (1500 ppm)
ORP (mV)	-115	-110	-102	-112	-105	75	32	74	20
TCL (ppm)	0	0	0	0	0	0.4	0.2	0.5	0.8
FRC (ppm)	0	0	0	0	0	1.5	0.8	1.45	0.5

Fig. 1 (ORP, TCL & FRC)



	Blank	DBNPA (50 ppm)	QUAT (50 ppm)	ISO (50 ppm)	GLUT (50 ppm)	DMH (150 ppm) + Hypo	BROMIDE (250 ppm) + Hypo	Ammonium Sulphate (250 ppm) + Hypo	Hypo (1500 ppm)
VFA (ppm)	15861	15197	15534	15186	14862	13256	15087	13568	15321
TBC (cfu/ml)	2.80E+07	8.00E+06	1.10E+07	1.20E+07	1.00E+06	3.20E+05	1.00E+07	4.30E+05	2.40E+06
SRB	1.00E+06	1.00E+05	1.00E+06	1.00E+06	1.00E+04	1.00E+03	1.00E+05	1.00E+03	1.00E+05

Fig. 2 (VFA, TBC & SRB)

Case Study 1:

A 100% recycled packaging mill was receiving complaints in Export Quality about odour coming from their Kraft Rolls. The odour included VFAs. The DMH program was started and there has been a remarkable reduction in complaints over the period of six months.

Case Study 2:

The Mill sent the Kraft Samples to abroad & all the sheets were rejected due to high odour. Mill started the program and significant reduction observed in the Paper. Hence Mill was awarded with big order.

Case Study 3:

A mill wanted to reduce the VFA levels in their final product as well in there ETP. Since the limitations in Fresh Water consumption, program was started with limited water sources &could able to stabilize the program with achieving the Mill's Target.

Case Study 4:

A Kraft mill was facing frequently odour issues & did a lot of actions to troubleshoot the issues but couldn't able to resolve. Finally the program was especially designed to cover all the inputs to treat the overall system. After struggling with N – Changes, finally could able to stabilize the program. Reduction in VFAs was not the criteria, the objective to design & develop the program was to satisfy the neighbors who were claiming the Odour Issues coming while passing through the Mill.

CONCLUSION

There are N Factors involved in Odour in pulp and paper especially in Kraft & Packaging Mill. With N Factors we have N Techniques to resolve the issues which includes mechanical & chemicals. The best is to select the best way or suitable product to resolve the Odour Issues.

DMH: NaOCl technology has proven to be especially effective against facultative anaerobic microorganisms and sessile bacteria, providing great reduction in VFAs which resultant in reducing odour issue and providing excellent machine cleanliness.

DMH stabilizer technology, by inhibiting the corrosion potential of NaOCl alone, can improve paper mill equipment integrity and extend machine runnability.

As desired, planktonic efficacy can be optimized by adjusting the DMH: NaOCl ratio.

Due to its operational flexibility and the feeding simplicity of neat blending, the stabilization of NaOCl by DMH is straightforward and uncomplicated to install and operate.

Above said technology needs proper care & said dosage may be vary Mill to Mill.

A TRIBUTE

R. K. GUPTA

7th August 1942 - 4th August 2018