

# Improving the Thermal Stability of Textile Fiber Finishes

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## Introduction

- Thermal decomposition of processing aids is an ever increasing issue since the thermal breakdown will result in serious economic and environmental problems.
- A special high temperature quartz crystal microbalance equipped with an on-line gas chromatograph has been designed for continuous in-situ evaluation of the rates of solid deposition and gas vaporization due to thermal breakdown of finishing aids.
- An increase in the fundamental understanding of thermal degradation will impact the development of processing aids across the industry and help the user to improve the selection and use of new classes of processing aids.

## Mechanism of Finish Thermal Degradation

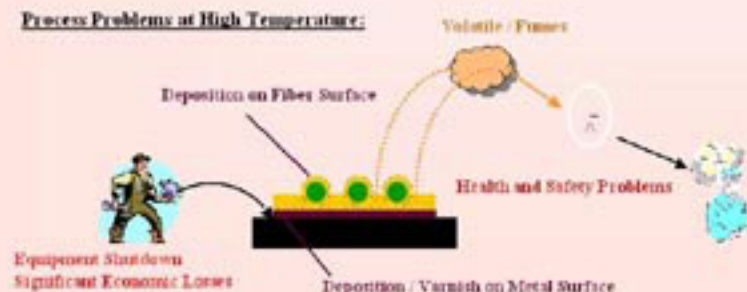


## Finishing Aid Thermal Degradation

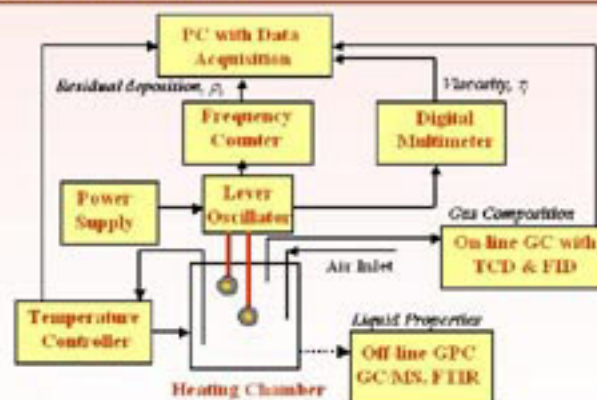
### Ideal Situation:



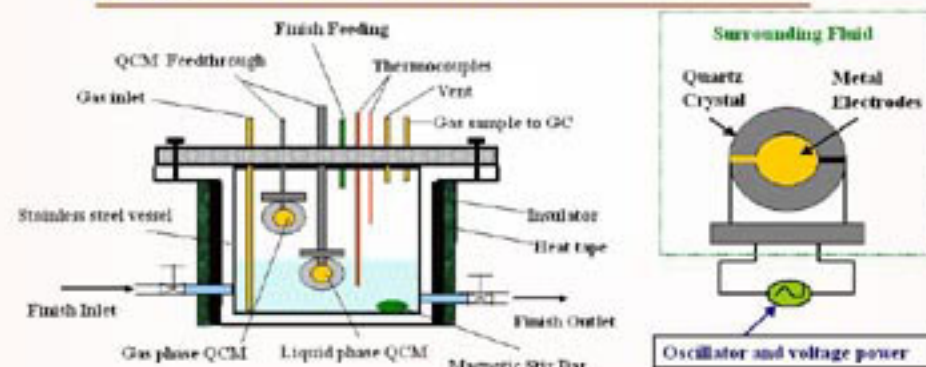
### Process Problems at High Temperature:



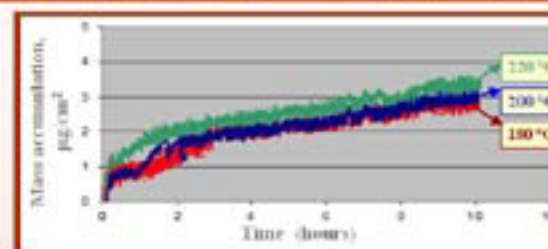
## Experimental System



## Quartz Crystal Microbalance Cell



## Mass Accumulation at Different Temperatures



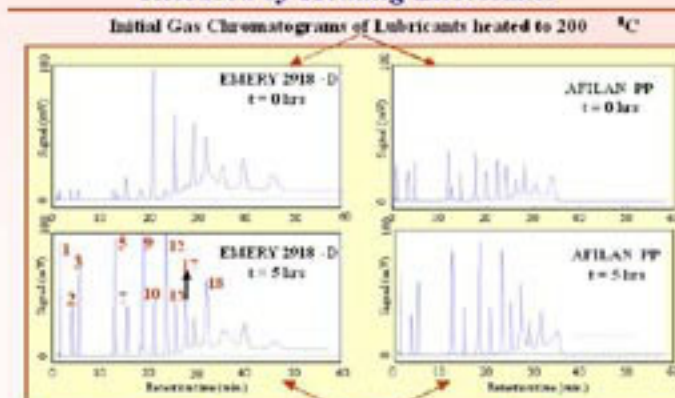
## Gas Chromatography - Mass Spectrometry - Results

More than sixty organic compounds were found in the condensed gas phase.

### Major products:

- Paraffin C1- C9
- Aldehydes C1- C9
- Methyl ketones C3- C9
- Carboxylic acids C1- C9
- Methyl esters C4- C11
- Alcohols and Olefins

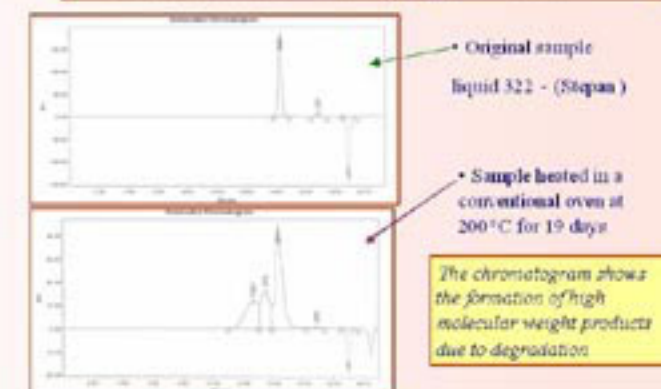
## GC Chromatograms of Volatile Compounds Released by Heating Lubricants



Gas Chromatograms of Lubricants heated to 200 °C after 4 hours.

Gaseous Sample was introduced directly to GC from the cell.

## Gel Permeation Chromatography - Results



## Conclusions and Future Goals

- In situ, real-time evaluation of the thermal behavior of various processing aids at elevated temperatures using the developed novel testing system.
- Systematic analyses of degraded products both in gas phase and in the liquid phase using GC, GC/MS, GPC, and TGA.
- Investigate factors such as functional additives and metal catalysts that affect the thermal degradation of processing aids.
- Elucidate dominating mechanisms related to the thermal degradation of processing aids; develop a kinetic model to describe and predict the thermal degradation process.
- Continue expansion of contact with suppliers and users of processing aids.

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