# Proposed Glass Manufacturing Certificate Program

Overview:

In order to provide relevance, it is proposed that the program starts with the participants identifying the important factors in the manufacturing of their glass products. In a general sense, the factors would include cost, quality, manufacturing efficiency, safety and environmental factors.

**It is my intent to have four major areas covered:**

- Raw Materials and Batch Plant Operation
- Melting and Glass Conditioning
- Forming
- Post Forming Operations

For each of these areas the appropriate topics from the items listed below in the outline would be incorporated. It should be noted that included and woven in would be appropriate statistics, QC, and Lean Manufacturing. In each of these areas one would then need to present how the factors given above are influenced by various choices, how they are measured and how they are controlled.

For each of these areas the following would be covered:

- Process description
- Key Control variables
- Measurement and Control Thereof
- Preventative Maintenance
- Trouble Shooting, Problem Solving
- Typical Problems/Defects/Solutions Including select War Stories
- Cost, Environmental and Safety considerations

Taking this approach, we can expand on the list in individual areas such as raw materials, melting, forming, and post forming.

As an example, if we look at raw materials, one would address the role of the different ingredients, how the amounts and sources of each are determined (cost, availability, quality, impurities, consistency, reliability, etc.). This would then lead into the unloading, storage, weighing (including the sensing and accuracy of the weighing device), mixing, and delivery to the furnace. Also included would be potential problems, and how said problems can be determined and resolved. Preventive maintenance when appropriate can be included.

Additional detail to the raw material discussion could be the importance of specific colors (optical transmission), how it is influenced by batch additions, how it is measured and controlled. Additional information would include melting oxidation and reduction factors and the control thereof.

As this approach is expanded to the complete manufacturing process, different aspects such as environment concerns, quality control (including regression analysis, correlation coefficients, signal to noise ratios, control limits, sensors, feedback loops, process modeling), relevant equipment and processes are added.

Since the member companies make different glass products, the option exists to pick and choose appropriate modules that fit the individual company's needs.

The end result would be a series of lessons that incorporate most of the topics suggested to date from an ad hoc group of GMIC member advisors, but presented with a focus on the relevance and importance to various aspects of the glass manufacturing process.

**Here is a strawman proposal for a series of modules.**

- Important factors in glass manufacturing
- Raw Materials and their function
- Batch formulation and mixing considerations (how a batch plant works)
- Raw Materials- potential problems
- Melting reactions
- Melting methods and efficiency (advantages and disadvantages)
    - Measurement and control
- Melting problems
- Optical transmission/color
- Environmental concerns (pollution, Emissions, wastewater, etc.)
- Glass Conditioning
- Viscosity
- Delivery methods and controls
    - Electro-mechanical systems
- Forming – Bottles
    - Float Glass
    - Fiber
- Product Considerations (weight, strength, safety, transportation costs, etc.)
- Measurement and Control systems
- Inspection Systems
- Quality Control Methods
- Preventive Maintenance
- Statistical Methods (uses and limitations)
- Property Measurements

- Defect Analysis and probable causes
- Health and Safety Hazards
- Post Forming Process
    - Coatings
    - Cutting
    - Annealing
    - Handling
- Problem Solving Techniques, War Stories
- People Management and Communication Skills

LSS Greenbelt?? My preference would be to integrate the LSS green belt principles into the relevant modules instead of having it offered as a separate module.

I should add that such modules might be helpful to bring on line new BS and MS hires whose education is not in the field of glass or material science, such as Mechanical and Electrical Engineers.