PROJECT DATA

Alfred University - 02GO12048

Selective Batching for Improved Commercial Glass Melting

Recipient:	Alfred University	Instrument Number:	DE-FG36-02GO12048
Recipient Project Director:	Diane Vossler 607.871.2487 2 Pine Street Alfred, NY 14802-1296	CPS Number:	1823
		HQ Program Manager:	Lisa Barnett 202.586.2212
		GO Project Officer:	Gibson Asuquo 303.275.4910
Recipient Type:	Institution of Higher Learning	GO Contract Specialist:	Melissa Wise 303.275.4907
Subcontractor(s):		B&R Number(s):	ED1805000
		PES Number(s):	02-2274
EERE Program:	Industrial Technologies	State Congressional District	NY - 31

PROJECT SCOPE: The objective of this project is to demonstrate that selective pre-batching of raw material feed stocks prior to their introduction to the glass furnace will reduce initial viscosity differences and minimize the tendency for segregation between alkali and alkaline earth salts in the batch. Several binary components will be batched and heated to determine low temperature segregation tendencies. A 10% reduction in furnace residence time, resulting in industry-wide savings of 20 trillion Btu/yr, is anticipated. A corresponding reduction in energy consumption and CO, CO_2, and NOx is expected.

FINANCIAL ASSISTANCE

Approved DOE Budget	$40,000	Approved DOE Share	$40,000
Obligated DOE Funds	$39,913	Cost Share	$14,000
Remaining Obligation	$0		
		TOTAL PROJECT	**$54,000**
Unpaid balance	$87		

Project Period: 9/1/02 - 7/31/03

TECHNICAL PERFORMANCE

DE-FG36-02GO12048

Alfred University

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PROJECT SYNOPSIS

The objective is to demonstrate that selective pre-batching of raw material feed stocks prior to their introduction to the glass furnace will reduce initial viscosity differences and minimize the tendency for segregation. The anticipated benefits are reduced residence times in the initial melting stage, reduced fining times, the potential to reduce the use of sulfate raw materials, and increased throughput, resulting in significant energy savings and reduced emissions. A 10% reduction in furnace residence time, resulting in industry-wide savings of 20 trillion Btu (16 billion cubic feet of natural gas per year) is anticipated. A corresponding reduction in energy consumption is expected to provide similar reductions in CO, CO_2, and NO_x emissions.

SUMMARY OF TECHNICAL PROGRESS

Several binary components (pairs of Na_2C0_3, Na_2SO_4, $CaC0_3$, $MgC0_3$, and quartz) were batched and melted to form a homogeneous melt, then re-melted in a high temperature viscometer to determine the dependence of viscosity on temperature. The reaction rates, melting, and decomposition temperatures were determined by simultaneous Differentiated Thermal Analysis-Thermogravimetric Analysis (DTA-TGA) and verified by literature values where possible. Samples were heated to low temperatures (over the range of 600°C to 1100°C) and times (from 0.25 to 24.0 hours on a non-linear time scale) to determine the low temperature segregation tendencies.

The commercial batch material and in-house samples were prepared by two different approaches, NCDS (a mixture of soda ash, limestone, dolomite, and silica) and NCS (a mixture of soda ash, limestone, and silica). They were then heated to low temperature to determine the low temperature segregation tendencies. The NCDS sample melted relatively slowly compared to the NCS sample. Samples were again prepared as before to determine batch-free time using established procedures fired over a higher temperature range. The NCS sample showed a reduction of 81% in batch-free time and the NCDS sample showed a 92% reduction in batch-free time. For completeness, a 62% decrease was found when the particle size was simply reduced and a 12.5% reduction was found for reduced particle size and selective batching combined. Based on the microstructural analysis, large scale segregation may be an issue.

This project has shown that dramatic reductions in the time required for a homogeneous glass melt are realized by forcing alternative reaction paths during the initial stages of melting. There were difficulties demonstrating segregation during the initial stages of melting in the laboratory. However, the selective batching approach has resulted in dramatic reductions in the time necessary to reach a batch-free state for a wide range of test conditions. This indicates that both selective pre-reacting and selectively pelletizing can reduce the batch-free time by at least 80%.

SUMMARY OF PLANNED WORK

The project is complete and the Final Report was submitted in September 2003.

PROJECT ANALYSIS

The project is complete and has been closed out.

ACTION REQUIRED BY DOE HEADQUARTERS

No action is required from DOE Headquarters at this time.

STATEMENT OF WORK
DE-FG36-02GO12048
Alfred University
Selective Batching for Improved Commercial Glass Melting

Detailed Task Description

Task 1. Binary Reactions

Several binary components (pairs of Na_2CO_3, Na_2SO_4, $CaCO_3$, $MgCO_3$, and quartz) will be batched, melted to form a homogeneous melt, and then re-melted in a high temperature viscometer to determine the dependence of viscosity on temperature. The reaction rates, melting, and decomposition temperatures will be determined by simultaneous DTA-TGA and verified by literature values where possible. Milestone: A report compiling the melting and viscosity data indicating problematic and feasible binary mixtures.

Task 2. Low Temperature Reactions

Prepared samples of commercial batch and samples prepared via Approaches I and II will be heated to low temperature (over the range of 600°C to 1100°C) and time (from 0.25 to 24.0 hours on a non-linear time scale) to determine the low temperature segregation tendencies. It is proposed to use relatively large crucibles (10 cm diameter and 25 cm tall) to conduct the low temperature reactions. Milestone: Preparation of samples for Task 4.

Task 3. High Temperature Reactions

Prepare samples of commercial batch and samples prepared identically to those in Task 2 but fired over the temperature range of 1000°C – 1200°C to determine batch free time using established procedures. Milestone: Preparation of samples for Task 4.

Task 4. Microstructural Analyses

Micro structural (via optical microscopy and SEM), phase (via XRD), and chemical (via SEM-EDS) analysis of the crucibles will be conducted to quantify the phase evolution and degree of segregation in samples prepared from Tasks 2 & 3. Milestone: Compilation of micro structural, phase, and chemical analysis describing segregation within heated batches.

Task 5. Reporting

Reports will be generated monthly and distributed via email to the industrial partners and DOE. Milestone: Publication of report and dissemination to the industrial partners and DOE.

Project Cost Performance in DOE Dollars for Fiscal Year 2003

DE-FG36-02GO12048 **Alfred University**

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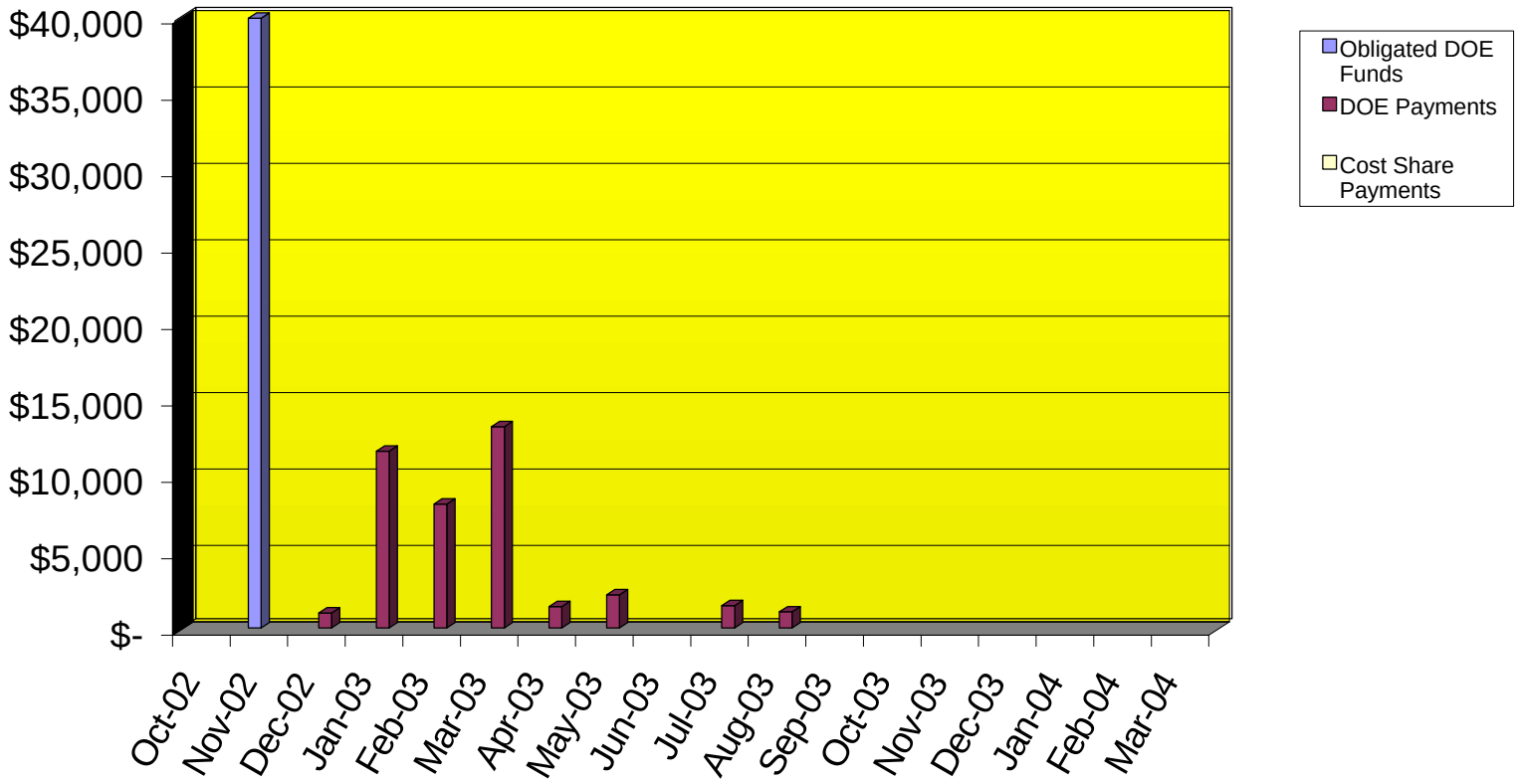

	Oct-02	Nov-02	Dec-02	Jan-03	Feb-03	Mar-03	Apr-03	May-03	Jun-03	Jul-03	Aug-03	Sep-03
Obligated DOE Funds	$0	$39,913	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
DOE Payment	$0	$0	$980	$11,573	$8,107	$13,167	$1,400	$2,174	$0	$1,454	$1,058	$0
Cost Share Payment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0

	Oct-03	Nov-03	Dec-03	Jan-04	Feb-04	Mar-04	PFY*	Cumulative
Obligated DOE Funds	$0	$0	$0	$0	$0	$0	$0	$39,913
DOE Payment	$0	$0	$0	$0	$0	$0	$0	$39,913
Cost Share Payment	$0	$0	$0	$0	$0	$0	$0	$0

Approved DOE Budget:	$40,000
Approved Cost Share Budget:	$14,000
Total Project Budget:	$54,000

* Prior Fiscal Years

Alfred University - 02GO12049

ID	Task Name	Start	Finish
1	Binary Reactions	Mon 9/2/02	Thu 10/10/02
2	Low Temperature Reactions	Mon 9/16/02	Fri 11/29/02
3	High Temperature Reactions	Fri 10/4/02	Fri 11/29/02
4	Microstructural Analysis	Fri 11/1/02	Wed 1/15/03
5	Project Mgmt and Reporting	Mon 9/2/02	Thu 1/30/03