14:51:16 OCA PAD INITIATION - PROJECT HEADER INFORMATION 03/30/93

Active

Project #: E-19-X15 Cost share #: Rev #: 0
Center # : 10/24-6-R7753-0A0 Center shr #: OCA file #:
Work type : RES
Contract#: RL46608 Mod #: INITIATION Document : PO
Prime #: NAS1-18888 Contract entity: GTRC

Subprojects ? : N CFDA:
Main project #: PE #:

Project unit: CHEM ENGR Unit code: 02.010.114
Project director(s):
MUZZY J D CHEM ENGR (404)894-2882

Sponsor/division names: LOCKHEED AERONAUT SYS CO-GA /
Sponsor/division codes: 261 / 007

Award period: 921109 to 930601 (performance) 930601 (reports)

Sponsor amount	New this change	Total to date
Contract value	6,147.00	6,147.00
Funded	6,147.00	6,147.00
Cost sharing amount		0.00

Does subcontracting plan apply ?: N

Title: THERMOKINETIC MODELING OF RESIN TRANSFER MOLDING RESIN

PROJECT ADMINISTRATION DATA

OCA contact: Jacquelyn L. Tyndall 894-4820

Sponsor technical contact

(000)000-0000

Sponsor issuing office

JIM JUVINALL
(404)494-7089

LASC - GEORGIA
MAIL CODE 510
86 SOUTH COBB DRIVE
MARIETTA, GA 30060

Security class (U,C,S,TS) : U ONR resident rep. is ACO (Y/N): N
Defense priority rating : DO-A1 supplemental sheet
Equipment title vests with: Sponsor GIT X
NONE PROPOSED
Administrative comments -
INITIATION OF PROJECT.

5R350

GEORGIA INSTITUTE OF TECHNOLOGY
OFFICE OF CONTRACT ADMINISTRATION

NOTICE OF PROJECT CLOSEOUT

Closeout Notice Date 06/01/95

Project No. E-19-X15_____ Center No. 10/24-6-R7753-0A0_

Project Director MUZZY J D_____ School/Lab CHEM ENGR_____

Sponsor LOCKHEED AERONAUT SYS CO-GA/_____

Contract/Grant No. RL46608_____ Contract Entity GTRC

Prime Contract No. NAS1-18888_____

Title THERMOKINETIC MODELING OF RESIN TRANSFER MOLDING RESIN_____

Effective Completion Date 930601 (Performance) 930601 (Reports)

Closeout Actions Required:	Y/N	Date Submitted
Final Invoice or Copy of Final Invoice	Y	_____
Final Report of Inventions and/or Subcontracts	Y	_____
Government Property Inventory & Related Certificate	N	_____
Classified Material Certificate	N	_____
Release and Assignment	Y	_____
Other _____	N	_____

Comments_____

_____

Subproject Under Main Project No. _____

Continues Project No. _____

Distribution Required:

Project Director	Y
Administrative Network Representative	Y
GTRI Accounting/Grants and Contracts	Y
Procurement/Supply Services	Y
Research Property Managment	Y
Research Security Services	N
Reports Coordinator (OCA)	Y
GTRC	Y
Project File	Y
Other _____	N
_____	N

E: Final Patent Questionnaire sent to PDPI.

E-17-X15 # 1

23-March-1993

To: Emilio Ferrer - Lockheed

From: Mach DeBenedictis - Georgia Tech

Re: Kinetic Model Constants for PR-500

Emilio:

A Viscosity model as a function of extent of reaction has been developed for the PR-500 resin. Viscosity vs time data was extracted from 3M's PR-500 data sheet, which you had supplied to me. The PR-500 kinetic model which was developed earlier was used to develop time, extent of reaction, and rate of reaction data for each of the 5 temperatures shown on the viscosity data sheet. From this data, the extent of reaction at any time-temperature combination could be determined. Both these data sets were used to construct temperature, extent of reaction, and viscosity tables. This data table was fit using a non-linear least squares curve fitting routine contained in the JMP for Macintosh computer program. The model suggested by M. Bruschke was found to be inadequate (see output). As similar model suggested by Lee, Loos and Springer ("Heat of Reaction, Degree of Cure, and Viscosity of hercules 3501-6 Resin", W.I. Lee, A.C. Loos, and G.S. Springer, University of Michigan) was also found to provide a poor fit. A model suggested in the report "Computer Aided Curing of Composites" (McDonnell Douglas Corp, July-1986), was found to yield a good fit. The model used FITTING THE LN(VISCOSITY) (in centipoise):

$$\frac{1}{(A1+A2 \cdot Temp\ (K)) + \left(\frac{(c1+c2 \cdot Temp\ (K)) \cdot Extent}{100}\right)}$$

where: A1, A2, c1, and c2 are constants.
Extent of reaction ranges from 1-100 (%)

The fitted values are:

A1	-2.823
A2	0.007174
c1	2.539
c2	-0.006448

Included with this fax is the JMP non-linear fitting output. Time vs Viscosity and Extent of Reaction vs Viscosity graphs of the raw data and the model fit are also included. As can be seen, the agreement at 354, 372, and 390 deg F is excellent. The fits at 310 F and 320 F are adequate, with the biggest problems being at short times and low temperatures. It should be remembered, that the largest errors with the kinetic model occurred at low temperatures. Since the extent of reaction data used in this analysis comes from the kinetic model, perhaps errors are being carried through. However, a plot of viscosity data vs model data shows overall good agreement.

If you have any question, please call.

Regards,

Mach DeBenedictis
(404) 894 - 2897