1:50:20 OCA PAD INITIATION - PROJECT HEADER INFORMATION 08/10/87

Project # E-18-640_____ MOD # _____ REV # 0__
Contract # 5 R01 DE07754-02_____ OCA file # ___ Status A
Contract entity GTRC Prime contract # _____
PDPI MAREK M I_____ (DR.
SSN 259-84-5914 Unit MAT ENGR Phone ( ) -
Project unit MAT ENGR Unit code 02.010.112
Sponsor/Division DHHS/PHS/NIH_____ / NATL INSTITUTE OF HEALTH_
Sponsor#/division # 108 / 001
Type of document GRANT__
Award period: from 87 / 08 / 01 to 88 / 07 / 31 (perf) 88 / 10 / 31 (rpts)

Sponsor amount	New this change	Total to date
Contract value	$ 140041	140041
Funded	$ 140041	140041

Cost sharing # _____ Cost sharing $ _____
Does subcontracting plan apply? (Y/N) N
Title -
DISSOLUTION OF MERCURY FROM DENTAL AMALGAMS_____

CTR project # R6363-0A0_____ CTR cost sharing # _____

Are there existing subprojects? (Y/N) N
Is this a subproject? (Y/N) N Main project # _____
Continuation of project # E-18-626_____ Type of research RES____

Coproject director name

_____
SSN - - Unit

Coproject director name

_____
SSN - - Unit

PROJECT ADMINISTRATION DATA

Administrative data OCA contact E. FAITH GLEASON____ PAD CO EFG 894-4820

Sponsor technical contact	Sponsor issuing office
WILLIAM E. ROGERS, JR. PH.D._____	ROBERT GINSBURG_____
(301) 406 - 7884	(301) 496 - 7437
CHIEF, CARIES AND RESTORATIVE_____	GRANTS MANAGEMENT OFFICER_____
MATERIALS RESEARCH BRANCH, NIDR_____	EXTRAMURALS PROGRAMS, NIDR_____
BETHESDA, MD20892_____	BETHESDA, MD 20892_____

Security class (U,C,S,TS) __ ONR resident rep. is ACO (Y/N) N
Defense priority rating _____
_____ supplemental sheet
Equipment title vests with Sponsor _ GIT X Comment follows - NONE

Admin comments -
INITIATION. 02 YEAR OF CONTINUING GRANT APPROVED FOR 3 YEARS._____

GEORGIA INSTITUTE OF TECHNOLOGY OFFICE OF CONTRACT ADMINISTRATION

SPONSORED PROJECT TERMINATION/CLOSEOUT SHEET

Date 10/26/88

Project No. E-18-640 / R6363-0A0 School/~~Lab~~ Mat. Engr.

Includes Subproject No.(s) N/A

Project Director(s) M. I. Marek GTRC/~~GTI~~

Sponsor DHHS/PHS/NIH/National Institute of Health

Title Dissolution of Mercury From Dental Amalgams

Effective Completion Date: 7/31/88 (Performance) 10/31/88 (Reports)

Grant/Contract Closeout Actions Remaining:

- [ ] None
- [X] Final Invoice or Copy of Last Invoice Serving as Final
- [ ] Release and Assigument
- [ ] Final Report of Inventions and/or Subcontract:
  Patent and Subcontract Questionnaire sent to Project Director [ ]
- [ ] Govt. Property Inventory & Related Certificate
- [ ] Classified Material Certificate
- [ ] Other

Continues Project No. E-18-626 Continued by Project No. E-18-656

COPIES TO:

Project Director
Research Administrative Network
Research Property Management
Accounting
Procurement/~~GTRI Supply Services~~
~~Research Security Services~~
Reports Coordinator (OCA)
~~Program Administration Division~~
Contract Support Division
~~Facilities Management ERB~~
~~Library~~
GTRC
Project File
Other

SECTION IV PROGRESS REPORT SUMMARY	GRANT NUMBER DE07754-03	
PRINCIPAL INVESTIGATOR OR PROGRAM DIRECTOR	PERIOD COVERED BY THIS REPORT	
MAREK, MIROSLAV I.	FROM	THROUGH
APPLICANT ORGANIZATION Ga Tech Research Corp. Georgia Institute of Technology	08/01/87	07/31/88

TITLE OF PROJECT *(Repeat title shown in item 1 on first page)*

DISSOLUTION OF MERCURY FROM DENTAL AMALGAMS

(SEE INSTRUCTIONS)

1. Summary of research plans for the next year of support

There has been no change in the objectives, specific aims, and experimental design and methods from those originally proposed.

2. Studies performed

While the emphasis in the first year was on the determination of the general mechanism of mercury dissolution, in the second year the program has been focused on the development and application of appropriate methods for the determination of the kinetics of mercury dissolution. The experimental approach has been to determine the changes in the mercury concentration in a fixed volume of the solution to which the specimens were exposed. The determination was performed by Atomic Absorption Spectrophotometry (AAS) using a cold-vapor techniques. The concentration changes were analyzed theoretically and experimentally, taking into account the fact that the rate of dissolution changes with time, and that the rate also is a function of the concentration of mercury in the solution. The objectives were accomplished by making sequential exposures into fresh volumes of the solution with little time between exposures and without exposing the specimens to air or other electrolytes between the exposures. The concentration data were processed using a nonlinear regression based on a theoretical model; the effect of mercury concentration was theoretically derived, while the change of the dissolution rate with time was modeled using the experimental data. The results of this procedure are the rate constants which then can be used to evaluate the effects of any variable.

The methodology was applied in a study of the effect of the composition of the gamma-1 phase of dental amalgam on the kinetics of mercury dissolution. Two sets of specimens were prepared, one set containing only Hg and Ag in different proportions within the range possible in dental amalgam (68 to 71.5 w.% Hg); specimens of the other set contained a fixed amount of Hg (68 w.%) and varying amounts of Sn within the range reported for dental amalgam (up to 1.5 w.% Sn). The specimens were exposed to synthetic saliva at 37°C in a special cell designed for the sequential exposures. The results show that the Hg/Ag ratio had little influence on the Hg dissolution rate, except for a sharp increase in the rate when the phase boundary with Hg was approached. The effect of tin was substantial; increasing the percentage of tin decreased the dissolution rate and also decreased the time constant for the dissolution rate change, so that the rate dropped more sharply. The effects were attributed to the formation of a tin oxide surface film which slows down the dissolution of mercury. The results explain the sharp increases in mercury release after chewing; the abrasion involved destroys the tin oxide film which is then reformed. The results also confirmed that tin must be dissolved in the gamma-1 phase rather than present in tin-rich precipitates.

MAREK, MIROSLAV I.
Ga Tech Research Corp. 08/01/87 07/31/88
Georgia Institute of Technology

DISSOLUTION OF MERCURY FROM DENTAL AMALGAMS

Another part of the study concerns the form in which mercury enters the solution, ionic or atomic (nonionized), and the relative quantities if both forms participate. The form is very important for the effect of the electrode potential, and therefore for the effects of galvanic and other corrosion cells. To determine the form of dissolving mercury a special cell system was designed which allows the solution to be analyzed by AAS either for atomic mercury only, or for total mercury. The amount of ionic mercury is then determined as the difference between the two data. This study is now in progress; the first results have indicated that at lower electrode potentials most of the dissolving mercury is in the atomic form, and that the amount of ionic mercury increases with the potential.

The methodology developed to date will be applied in the third year to evaluate the effects of different corrosion cells, temperature, and abrasion.

3. Human subjects

Not applicable - no human subjects involved.

4. Vertebrate animals

Not applicable - no vertebrate animals involved.

5. Publications

M. Marek: "Mercury Dissolution from the Gamma-1 Phase of Dental Amalgam." IADR/DMG Microfilm, 66th General Session of the International Association for Dental Research, March 9-13, 1988, Montreal, PQ, Canada.