30 April 1984

National Aeronautics and Space Administration
George C. Marshall Space Flight Center
Marshall Space Flight Center, Alabama 35812

SUBJECT: Final Report for Contract NAS8-35822
"Feasibility Study of a Color Film Preservation System"

Gentlemen:

The attached final report is submitted to fulfill the reporting requirements on the subject contract for the total period of performance.

Sincerely,

J.H. McDermid
Program Manager

JHM/11b

encl.

Report Distribution:

AP29-F
AS24-D
AT01
NASA Scientific and Technical Information Facility
FINAL REPORT
COLOR FILM
PRESERVATION SYSTEM
-BREADBOARD DEVELOPMENT-

CONTRACT -- NAS8-35822

THIS REPORT WAS PREPARED
FOR
THE TECHNOLOGY UTILIZATION OFFICE
AT01

SUBMITTED TO:
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MARSHALL SPACE FLIGHT CENTER
MARSHALL SPACE FLIGHT CENTER, AL 35812

SUBMITTED BY:
ELECTRO-OPTICS CONSULTANTS, INC.
2512 GARTH ROAD
HUNTSVILLE, AL 35801

30 APRIL 1984
<table>
<thead>
<tr>
<th>SECTION TITLE</th>
<th>PAGE NO.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUMMARY OF RESULT</td>
<td>1</td>
</tr>
<tr>
<td>BACKGROUND</td>
<td>1</td>
</tr>
<tr>
<td>OBJECTIVES</td>
<td>3</td>
</tr>
<tr>
<td>RESULTS</td>
<td>3</td>
</tr>
<tr>
<td>CYLINDRICAL CONTAINER (Fig. 1)</td>
<td>4</td>
</tr>
<tr>
<td>BREADBOARD DESIGN</td>
<td>5</td>
</tr>
<tr>
<td>SYSTEM SCHEMATIC (Fig. 2)</td>
<td>6</td>
</tr>
<tr>
<td>SYSTEM CARRYING CASE (Fig. 3)</td>
<td>7</td>
</tr>
<tr>
<td>CONCLUSIONS</td>
<td>8</td>
</tr>
<tr>
<td>REFERENCES</td>
<td>9</td>
</tr>
</tbody>
</table>
SUMMARY OF RESULT

During this interim study the following have been accomplished:

- Additional leakage data was collected on the cylindrical storage concept developed during Phase I. Results indicate that long term storage is feasible with this concept.

- A system was designed and fabricated for collecting oxygen content data for use during Phase II of the study.

- A breadboard of an operational system was built for the purpose of collection of data and for the purpose of system demonstration.

Details of these results are presented in this report.

BACKGROUND

It has been determined that high speed color transparencies made from film such as Ektachrome and Fujichrome experience dye fading in a relatively short period of time. These films are used in the medical profession to record the retinal reflex images of individuals. It is important to keep these records from deterioration in order to keep medical histories for diagnosis, preventative care, etc.

Further, significant degradation of valuable skylab experiment film was noticed in 1974. The specific film of concern was the SO-242 film flown on ATM experiment S-056 during Skylab 4. Degradation occurred in color balance changes resulting
from organic dye instability (REF.1). In 1975 action was taken to quantify the rate of degradation and to store the film in an environment to decrease or stop degradation (REF.2). Accelerated tests were conducted at MSFC that indicated that dye fading of the film could be totally arrested or greatly retarded by placing the film in a nitrogen environment. The film was stored in the nitrogen environment and after a period of 29 months it was found that the storage system was highly successful.

It was the objective of Phase I of this study to determine the feasibility of developing an economically feasible system to prevent and/or substantially reduce the degradation of the color dyes of the retinal reflex images recorded on color slide films. This study drew upon the system developed by NASA-MSFC to preserve Skylab films. This system basically consists of a sealed container containing a dry nitrogen gas (GN₂) and is patented under:

"METHOD FOR RETARDING DYE FADING DURING ARCHIVAL STORAGE OF DEVELOPED COLOR PHOTOGRAPHIC FILMS"

PATENT NO: 4,287,152
The objective of Phase I of this study was accomplished by designing, fabricating, and testing three different types of film storage systems. In Phase I it was concluded that an extruded plastic container such as that shown in Figure 1, could be developed into an economically feasible concept for storing films for extended periods of time. (REF.4)

OBJECTIVES

The following are the objectives defined for the interim effort between Phase I and Phase II of this study.

- Continue collecting leakage data on the cylindrical concept
- Design a system for collecting oxygen content data for use in Phase II.
- Build a mock-up of the system planned for mass storage.

RESULTS

The cylindrical container was pressurized and no observable leakage occurred, indicating that long term storage is feasible with this concept.

A survey was conducted to determine the availability, accuracy, cost, etc., of equipment available for measuring oxygen content. Oxygen content data is required to determine storage system purging requirements, the feasibility of attaining oxygen
FIGURE 1: CYLINDRICAL CONTAINER
levels low enough to minimize degradation, and the economics of the system in general from the viewpoint of the nitrogen requirements. It was found that an electro chemical fuel cell type sensor was best for the application being studied (REF.5). A survey of this type sensor was made and one was selected and purchased for the breadboard.

BREADBOARD DESIGN

The original objective was to build a mock-up of the system for storage. This mock-up was to include mock-ups of N₂ storage, monitors, etc. However, the decision was made that it would be more practical to build an operational breadboard by utilizing additional contractor funds. This system has been fabricated and is operational. A schematic of the system is given in Figure 2 and a photo of the system in its carrying case is shown in Figure 3.

This system offers the capability to determine:

- Purging requirements to achieve various levels of oxygen concentration.
- Precise leakage of various container configurations.

This system has the following features:

- Digital display of oxygen content of container.
- Automatic control of oxygen content of container.
- Automatic control of container to atmosphere pressure differential.
- Flow rate readout during purging.
FIGURE 2: SYSTEM SCHEMATIC
CONCLUSIONS

A breadboard has been fabricated that will provide valuable data for prototype design during Phase II of this study. Further, with the compact packaging of the breadboard it provides a system that can be used to demonstrate the concept.
REFERENCES


