Proceedings of International Conference on Astronomy and Space Science
Celebrating 20th Anniversary of Korea Space Science Society, Jeju, 2004

A STUDY ON DEGREASING DETERGENT AND METHOD FOR THE IPP TEST FACILITY

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(Received September 25, 2004; Accepted October 1, 2004)

ABSTRACT

As a cryogen, LOx is a light blue, odorless, transparent liquid. Also it is not shock sensitive and does not decompose. However, it is a strong oxidizer and will vigorously support combustion. Therefore all harmful contaminants (such as grease, oil, fingerprint and organic materials) that could cause malfunctions, fires, or explosions in a oxygen environments must be completely removed prior to the introduction of oxygen. Especially, grease ingredient located inside of the LOx supply line, pipe and PHS (Pneumo-Hydraulic System) part can make drastic chemical reaction with oxygen. Therefore, to protect rapid reaction such as explosion, grease ingredient must be surely eliminated by a regular and irregular degreasing. Study on the availability, effectiveness and selection of degreasing detergents and method is described in this paper, and it will be useful for the construction and management of IPP test facility.

Keywords: IPP (Integrated Power Plant) test facility, KSLV (Korea Space Launch Vehicle), degreasing, Liquid Oxygen (LOx)

1. INTRODUCTION

IPP Test Facility will be constructed for the variety of tests on KSLV (Korea Space Launch Vehicle) Program in the Space Center. IPP test facility includes comprehensive testing equipments for liquid rocket launch vehicle. Using this facility, KARI will verify the adaptiveness of parts and subsystems for launch vehicle and finally qualify the system characteristics of launch vehicle carrying out various tests including hot firing test.

Liquid oxygen (LOx), kerosene, helium (He) and nitrogen (N2) will be used for propellants and pressurizing fluids in this facility. Among them, LOx is a strong oxidizer and will vigorously support combustion. Therefore all harmful contaminants (such as grease, oil, fingerprint and organic materials) that could cause malfunctions, fires, or explosions in a oxygen environments must be completely removed prior to the introduction of oxygen. Especially, grease ingredient located inside of the LOx supply line, pipe and PHS (Pneumo-Hydraulic System) part can make drastic chemical reaction with oxygen. Therefore, to protect rapid reaction such as explosion, grease ingredient must be surely eliminated by a regular and irregular degreasing (Edeskuty & Stewart 1996).

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Experiment was carried out and described in this paper to find out which degreasing detergents are more available and effective to space launch vehicle. Cleaning method, analysis process and the result of test are also reviewed.

2. CHARACTERISTICS OF DETERGENTS AND EXPERIMENTAL PROCEDURE

Detergents for the equipment of launch system should have high cleaning effectiveness and reliability to avoid catastrophic accident. There are many solvents commonly used for degreasing agent of the launcher and have excellent degreasing ability such as ethyl alcohol, MC, TCE, CCL4. However, some of them are limited to use and phased out by Montreal Protocol because of depletion of atmospheric ozone.

The purpose of this study is to select effective degreasing detergent and establish cleaning and analyzing procedures for IPP test facility. Characteristics of degreasing detergent required for launch system is as follows (Jeon 1999a).

1) Environmentally friendly and not limited by Montreal Protocol
2) Commercially available in domestic
3) Having a excellent degreasing ability
4) Easy to dry or have low heat of vaporization
5) Having a simple analysis method

At first, we choose MC (Dichloromethane), Ethyl alcohol, HFE-7100 and HFE-72DE as test degreasing detergents which are available in Korea.

Degreasing methods are classified into immersion, high pressure injection and ultrasonic cleaning. In case of high pressure injection, it cannot be applied to all cases despite of good degreasing ability. Ultrasonic cleaning method has a good degreasing ability than immersion cleaning method, but it needs additional equipments. Therefore, in this study the immersion cleaning method is used for experiment. Experimental procedure is as follows (Jeon 1999b).

Step 1. Prepare the specimen manufactured from SUS304 ($100 \times 100 \times 1$).
Step 2. Clean all experimental tools with MC (Dichloromethane).
Step 3. Choose contaminants (margarine, grease, Shell32, ISU chemical46).
Step 4. Dissolve the contaminants in acetic acid and mix them with distilled water to the density of 20mg/l respectively.
Step 5. Dip specimen into the contaminated water for 5 seconds to pollute them.
Step 6. Dry the specimen with hot winds during 10 minutes.
Step 7. Dip specimen into each degreasing detergent during 10 minutes.
Step 8. Analyze each degreasing detergent.

3. ANALYSIS PROCESS AND RESULTS

All contaminants that could cause malfunctions, fires, or explosions must be completely removed. Therefore, choosing the degreasing object and development of the degreasing procedure and the contaminant contents analysis method are very important work for degreasing of IPP test facility. First of all, degreasing objects should be all parts connected with LOx system. For example, before being placed in service, any equipments that might come into contact the gaseous or liquid oxygen must be cleaned according to established procedures. Established degreasing process (Figure 1) and contaminant contents analysis method (Figure 2) are as follows.

To analyze the degreasing detergents UV-VIS (extinction luminous intensity method) was used.

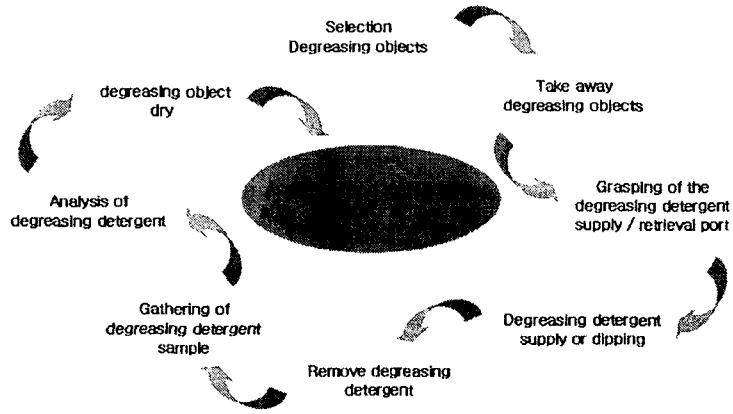

Figure 1. Degreasing process for IPP test facility.

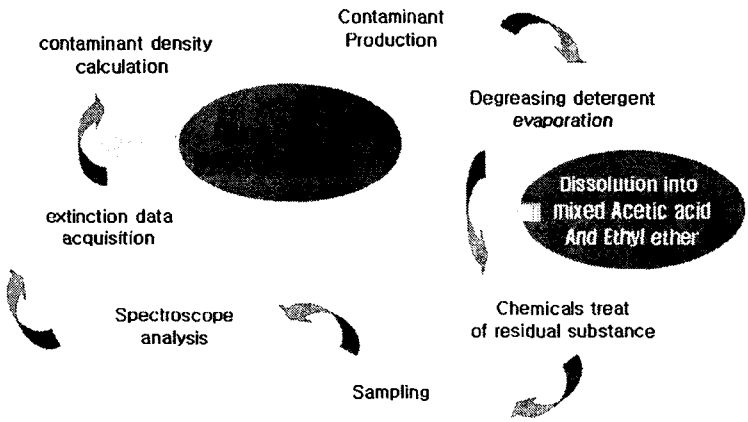

Figure 2. Contaminant content analysis method for IPP test facility.

Table 1. Contents of grease ingredient remained after degreasing process.

Detergents	Original	Margarine	Grease	Shell 32	ISU chemical46
M C(mg/l)	0.3	3	20	10	10
Ethyl alcohol(mg/l)	2.5	28	24	23	23
HFE-72DE(mg/l)	21.2	22	26	26	26
HFE-7100(mg/l)	2.5	8	23	10	10

Allowable amount of contaminant contents after degreasing is restricted to 5 mg/l or less than. Also, allowable amount of the contaminant contents for original degreasing detergent is strictly restricted within 2 mg/l (Lim 1995).

After contaminant contents analysis of original degreasing detergent, we get the extinction data about wavelength and contaminant contents using standard measuring line data. The results are as follows (Table 1).

4. CONCLUSIONS

The contents of grease ingredient in original degreasing detergent should be less than 2 mg/l. But the results except MC exceed the value. We made a decision that it is not the problem of original degreasing detergent but process; so it will be possible to obtain that value if manufacturing process, transportation and packing procedure are controled suitably. Contents of grease ingredient on each contaminant increased in comparison with orignal value. That is, it shows that degreasing was accomplished. We found that degreasing ability of the ethyl alcohol was better than others relatively but it has low flash point and easy to ignite. In case of MC and HFE group, they show similar degreasing ability. However, MC has a toxicity and characteristics of dissolving rubber and plastic material in valve or connection. Therefore, it is suitable to substitute environmentally friendly HFE group for MC when cleaning large objects such as storage tank. HFE group also can be used with rubber and plastic material. Consequently, HFE group is the preferred degreasing detergent considering cleaning effectiveness, toxicity and safety. The results of this study on detergent, degreasing method and analysis procedure will be the basic data for construction and management of the IPP test facility.

ACKNOWLEDGEMENTS: The present work is written as part of the "Research and Development of KSLV-I" supported by Ministry of Science and Technology.

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