LOW-GWP ALTERNATIVE FOR SMALL RIGID PU FOAM ENTERPRISES

WORLD BANK GROUP

Cyclopentane Foam Injection Machine

Introduction

The total production of rigid polyurethane (PU) foam in China is more than 700,000 MT a year. Rigid PU foams are widely used as insulation and structure materials in various products including appliances, reefer containers, pipes, and etc. More than 40,000 MT of HCFC-141b is used as a blowing agent by thousands of foam producers for which most of them are small producers that do not adequate technical and financial capacity to adopt hydrocarbon (cyclopentane) technology because of its high initial investment cost and safety requirements.

Cyclopentane technology has been employed widely in developed world and in large enterprises in developing countries. Cyclopentane is considered as a climate friendly alternative because of its low global warming potential. Rigid PU foam produced by cyclopentane as a blowing agent has excellent insulation performance and structural stability. However, most of smaller foam enterprises, which are majority of foam producers that are currently using HCFC-141b, do not have adequate technical and financial capacity to overcome technical challenges in dealing with the conversion process to cyclopentane and the high initial investment costs.

Hydrocarbon Sensor

Description and Challenges of the Project

To improve technical capacity in relation to adoption of cyclopentane technology of a large number of small foam producers, the project was, therefore, designed to assist a system house for which small foam enterprises rely on for their supply of raw materials and technical advice, to develop polyol, one of the major raw materials for foam production, pre-blended with cyclopentane, instead of HCFC-141b. This approach also enhances market penetration of this new product by using the existing market network.

Development of cyclopentane pre-blended polyol requires the system house to address not only the quality of the cyclopentane pre-blended polyol but also the final product quality and safety from its production facility until this raw material is delivered and consumed by its end customers, small foam enterprises. The project, therefore, involves assessment of the stability of cyclopentane pre-blended polyols, flammability, transportation, safety guidelines, and establishment of pre-blended polyol production capacity at the system house and conversion of four downstream enterprises producing foam for various products (i.e, discontinuous sandwich panels, commercial refrigerators, wine cabnites and small fridges, and electric water heaters).

Successes and Lessons Learnt

The demonstration project confirms good stability of cyclopentane pre-blened polyols. There are only a few cases of stratification at low temperature. Safety measures must be applied when using cyclopentane pre-blended polyols as the test results confirm that for cyclopentane pre-blended polyol formulation with a mass ratio of polyol and cyclopentane of 100 to 13 and higher is flammable. Containers for cyclopentane pre-blended polyols must have thickness of at least 1.22 mm in order to withstand the pressure vapor of at least 200 kPa.

Formulated polyols pre-blended with cyclo-pentane is classified as Grade II flammable liquid – flammable liquid with a flashpoint between 28°C and 45°C under the Chinese regulations. Transporting of this product must be conducted by authorised personnel. Vehicles, loading and off-loading equipment must meet the requirements for transportation of dangerous goods.

With the availability of cyclopentane pre-blended polyols, the requirements of large cyclopentane storage tanks are eliminated. This enables more smaller foam enterprises to adopt cyclopentane technology as a large area for accommodating storage tanks is not needed. As a results, the initial investment costs in terms of additional lands and storage tanks are not required and the production process is simplified, which make the technology more affordable.

Figure 1 – Existing HCFC-141b foaming set-up

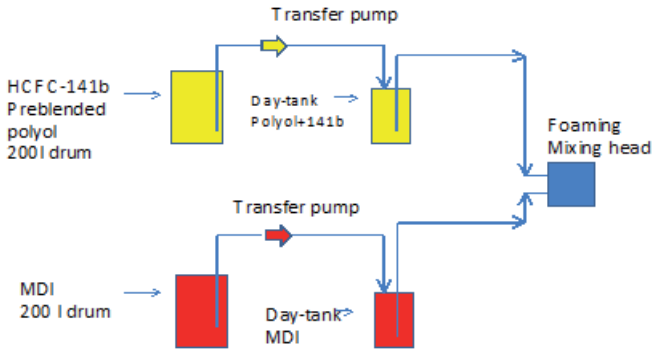


Figure 2 – Cyclo-pentane* foaming set-up

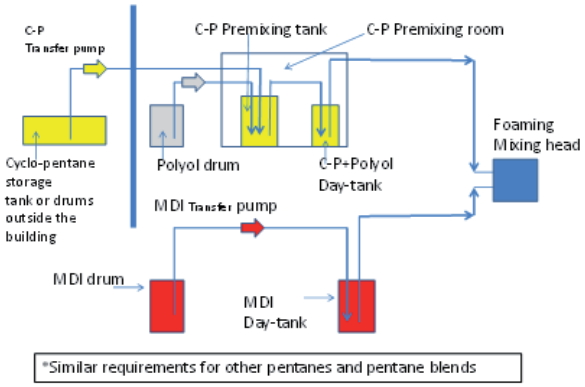
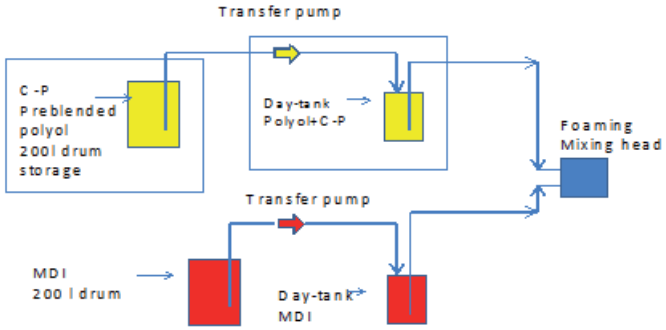


Figure 3 – Pre-blended C-P foaming set-up



The cyclopentane pre-blended technology as schematically described in Figure 3 were demonstrated at four foam enterprises in China. The final products of these companies show no compromise in the final product quality. However, the initial investment costs at these four foam enterprises are within the range of US$ 190,000 - US$ 340,000, which is lower than the cost of the typical cyclopentane technology set up of US$ 375,000 - US$ 445,000 (shown in Figure 2). While the operating cost of using cyclopentane is slightly higher than HCFC-141b blown foam, the increase in the operating cost is much lower than foam blown by other blowing agents such as HFC-245fa.

Because of the lower operating cost of producing foam with cyclopentane, most small foam enterprises prefer to adopt cyclopentane technology. With this project, small foam enterprises are now having access to the technology. More system houses are offering cyclopentane pre-blended polyols today.

Sources:

- Multilateral Fund
- World Bank

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