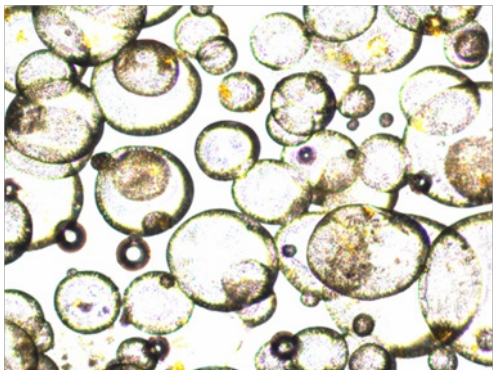
PACKAGE OPTIMIZATION with POLYMERIC MICROSPHERES (POPM)

PURPOSE:

The purpose of this project is to develop lightweight, high performance polymeric structures for military packaging applications in order to reduce the logistics burden for the Warfighter. The incorporation of polymeric microspheres will reduce the logistics burden by providing a ration with decreased weight and thus decreased reliance on fuel. (JSN 08-09)

TECHNOLOGY:

Polymeric microspheres are spherically shaped particles which behave like gas filled balloons that expand with the application of heat. Polymeric microspheres consist of a polyacrylonitrile shell encapsulating an isopentane gas. When the microspheres are heated, the thermoplastic shell softens and the gas inside expands. When the sphere is cooled, the polymer shell hardens, and a significant increase in the size of the microsphere is observed. Similar to structural insulation, polymeric microspheres contain pockets of air which retard the passage of heat and decrease thermal conductivity. Polymeric films loaded with less than 5 wt% microspheres, show significant decreases in density and thermal properties, while maintaining barrier and mechanical properties.



Optical Microscopy Micrograph of 5% Microspheres in Low Density Polyethylene

KEY FEATURES/BENEFITS:

- **Reduced Solid Waste —** Expandable polymeric microspheres are able to reduce the density of packaging materials, thus reducing the cost and weight of the finished package. In addition, raw materials are saved, due to the expansion of the polymeric microspheres and introduction of free volume into the packaging structure.
- **Multi-Functional Characteristics —** Polymeric microspheres also provide increased thermal insulation due to reduced heat transfer through the gas inside the microspheres.

Prototype 1% Microspheres Loaded MRE Meal Bag

FOCUS GROUP EVALUATION:

- Completed at Fort Devens with the 542nd Quartermaster Company in July 2014
- Prototype microspheres loaded Meal, Ready-To-Eat (MRE) Bag
  - Less tacky and less cumbersome, more compactable and easier to fit into cargo pockets
  - Noticeable weight reduction, easier to open but not too easy to open, no difference in noise signature
- Prototype microspheres loaded Flameless Ration Heater (FRH) Pouch
  - Prototype pouch allowed the heater to stay hotter much longer and participants could heat the side dish
  - Heat from the FRH was dispersed more evenly, as compared to the current pouch where heating is concentrated at the bottom of the FRH

Prototype 0.20% Microspheres Loaded Flameless Ration Heater Pouch

RESISTANCE TO STORED PRODUCT INSECT INFESTATION:

- Penetration assay exposed the prototype films to fifth instar Indian meal moth larvae over a 14 week period
- No failures observed with the prototype meal bag films, next step is to test the fully packed meal bag
- Stored product insect infestation with smooth and scratched meal bags, and roach infestation and rodent pilferage

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