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## Science, Technology, Research and Innovation for Development (STRIDE)

**PHASE I**

# Expanded Organo-Bentonite Nanofiller for High Value-Added Rubber Products

**PHASE II**

# Expanded Organo-Bentonite Nanofi ller for High Value-Added Rubber Products: The "Mixture" Approach to Multi-Functionality

**GRANTEE:** University of the Philippines Diliman (UPD)

**PRINCIPAL INVESTIGATOR:** Dr. Bryan Pajarito

**INDUSTRY PARTNER:** Philippine Rubber Industries Association (PRIA); Rhodeco Rubber

**COLLABORATING PARTNER:** Case Western Reserve University (CWRU)

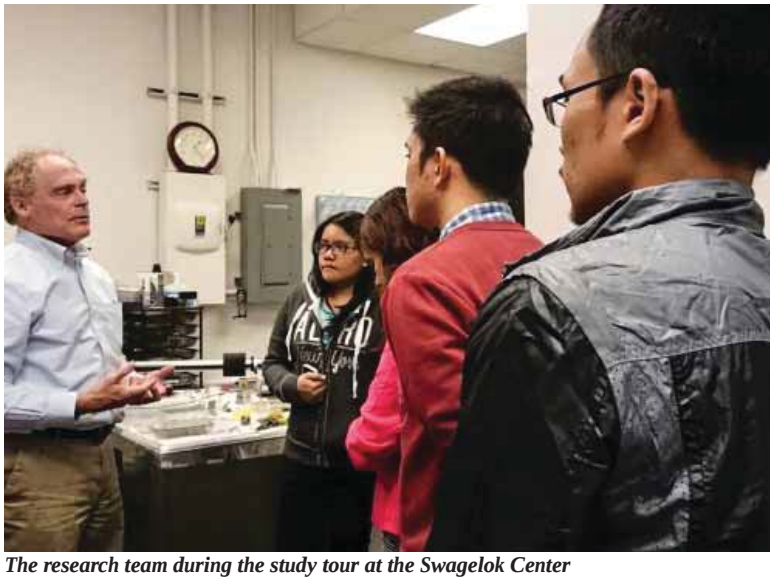
**GRANT PERIOD:** October 1, 2014 to October 31, 2016

**GRANT AMOUNT:** PHP7,892,229 (approximately USD168,000)

## Environment-friendly rubber filler

Conventional fillers such as carbon black (CB), precipitated silica, and natural clay have long been utilized as essential ingredients to reinforce rubber product for enhanced mechanical properties, improved processability, and reduced material cost. However, CB is harmful in nature and limits product color, precipitated silica is costly and decreases productivity and natural clay has poor reinforcing ability.

In search of solutions to reduce CB and silica precipitate without sacrificing quality and performance, UPD, with support from USAID STRIDE, initiated a research project to test the feasibility of expanded organo-bentonite nanofiller, an eco-friendly and cost-effective additive as reinforcing filler to vulcanized natural rubber. The introduction of new and cost-effective formulations in the utilization of expanded organo-bentonite nanofiller is also perceived to improve competitiveness of rubber products in the market.



*The research team during the study tour at the Swagelok Center*

In Phase 1, the research team was able to establish that an optimum formulation of expanded organo-bentonite nanofiller provides a balanced improvement to natural rubber in terms of hardness, mechanical properties, and water resistance. It was also discovered that each material property of natural rubber requires a specific, unique, and different formulation of expanded organo-bentonite to maximize improvement. The simultaneous improvement of all material properties of natural rubber and multi-functionality is difficult to achieve using a single optimum formulation of expanded organo-bentonite nanofiller.

## Milestones

The milestones that led to these findings are as follows:

- Completion of the expanded organo-bentonite nanofiller from locally available materials and chemicals;
- Utilization of the expanded organo-bentonite nanofiller for compounding and vulcanizing local natural rubber;
- Completion of testing processes of vulcanized natural rubber containing bentonite nanofiller; and
- Completion of three trainings that capacitated the research team, namely: a) training in polymer and *nano*-structured material design, synthesis, and characterization hosted by the research group of Dr. Rigoberto Advincula at the Department of Macromolecular Science and Engineering, CWRU, Cleveland, Ohio; b) training in rubber product compounding and vulcanization hosted by the PRIA care of Rhodeco Rubber Processing Services Inc.; and c) training in rubber product testing methods hosted by the Department of Chemical Engineering, UPD.

***A research team member tries an equipment at the Swagelok Center for Surface Analysis of Materials at Case Western Reserve University***

## Moving forward

These significant findings led to a Phase II of the project. In Phase II, the project focused on the mixture of expanded organo-bentonite as a multi-functional *nano* filler to simultaneously improve material properties of natural rubber and common synthetic elastomers such as styrene butadiene rubber and acrylonitrile butadiene rubber.

The three major goals of the project that were successfully accomplished are as follows:

- Utilization of the mixture of expanded organo-bentonite nanofiller that shows improvement of material properties of vulcanized natural rubber;
- Testing and application of the mixture of expanded organo-bentonite nanofiller as reinforcement to locally available synthetic elastomers; and
- Collaboration with small and medium-sized enterprises of the local rubber industry.

The Phase II of the project on expanded organo-bentonite also boosted the collaboration between UPD, local universities within STRIDE's priority geographical areas under the Cities Development Initiative (CDI), and US universities like CWRU. This further strengthens joint research undertakings for the economic development of the country.