

Nebraska Soybean Board

Year-End Summary Research Report Form For Multi-Year Projects

Please use this form to summarize the practical benefits of your research project and what has been accomplished.

Your answers need to convey why the project is important and how the results will impact soybean production.

Note that this form must be submitted with the 4th Quarter Report in all multi-year projects.

Project # and Title: Research on Soybean Oil as a Sustainable Recycling Agent

Principal Investigator: Hamzeh Haghshenas Fatmehsari

Year of Multi Year: 1 of 3 (For example: Year 1 of 3, Year 2 of 2)

1. What was the focus of the research project or educational activity?

The ultimate goal of this multi-phase research project is to evaluate the effect of soybean oil (i.e., crude and high oleic soybean oil), as a locally available, affordable, and environmentally – friendly recycling agent, on the performance of asphalt pavements containing recycled materials (e.g., reclaimed asphalt pavement (RAP)). The focus of the first year of this project was to identify the chemical species present in the soybean oil that may negatively affect the durability of asphaltic materials (i.e., asphalt binder and asphalt mixture) and improve soybean oil performance through physical and/or chemical treatments.

2. What are the major findings of the research or impacts of the educational activity?

-Crude soybean oil (SO) and high oleic soybean oil (HOSO) have high oxygen content which can negatively affect the long-term efficiency of the asphaltic materials by feeding oxygen to the oxidation process.
-SO and HOSO contain carbonyl groups like ester. The presence of carbonyl group in the structure of these oils can exacerbate the aging problem of asphaltic materials where these oils are introduced to asphalt mixtures as recycling agent.
-The LiAlH₄ reducing agent could successfully eliminate the carbonyl groups about 99%; however, the formation of hydroxyl group because of the reduction process can exacerbate the aging of asphaltic materials.
-In order to inhibit the oxidation of unsaturated acids in the soybean oils, three different antioxidants: zinc diethyldithiocarbamate (ZnDEC), butylated hydroxytoluene (BHT), and dilauryl thiodipropionate (DLTDP) were selected to be mixed with SO and HOSO. Mixing BHT and DLTDP with SO and HOSO resulted in a thorough mix, while ZnDEC remained undissolved. The efficacy of ZnDEC will be evaluated in the Phase II of the project in which the antioxidant can be directly added to the asphalt binder.
-SO+DLTDP and HOSO+DLTDP were thermally stable at the mixing and compaction temperatures of asphalt mixtures, while performance of the SO+BHT and HOSO+BHT samples were not satisfactory due to the high mass loss at temperatures below the mixing and compaction temperature of asphalt mixtures.

3. Briefly summarize, in lay terms, the impact your findings have had, or will have, on improving the productivity of soybeans in Nebraska and the U.S.

We aim to implement this research by placing and testing the asphalt mixture containing improved soybean oil and recycled materials (e.g., RAP) on a one-mile section of Nebraska road and monitor the performance of this section for a few years. If successful, the outcomes of this research will ultimately provide new use of soybean and create an expanded market for this oil. In addition, Nebraskans may find themselves with an improved economy and more sustainable asphalt roads.

4. Describe how your findings have been (or soon will be) distributed to (a) farmers and (b) public researchers. List specific publications, websites, press releases, etc.

The news about this project has been released in the University of Nebraska website and Nebraska TV. You can access the news from the links below:

<https://news.unl.edu/newsrooms/today/article/local-crops-could-provide-green-solution-for-blacktop-repair/>

<https://nebraska.tv/news/local/corn-and-soybeans-bring-potential-for-cheaper-road-repairs>

<https://engineering.unl.edu/making-blacktop-green-nebraska-engineers-using-soybean-oil-recycle-asphalt/>

We are also planning to disseminate our research results/outcomes by attending at national and international conferences and workshops as well as publishing our findings in scientific journal venues.

5. Did the NE soybean checkoff funding of your project, leverage additional State or Federal funding support? Please list sources and dollars approved.

The NE soybean checkoff funding of our project can potentially leverage additional funding in the next phases of the project.

Please email this completed form to the Agriculture Research Division (jmcmahon10@unl.edu) based on the reporting schedule given to you. If you have any questions, please call Jen McMahon at the ARD 2-7082.