Peanut Shells in Plastic: A Simple Explanation

Atanu Biswas, January 28, 2026

Peanut shells can be added to plastic as a cheap and environmentally friendly filler. This helps lower costs, reduces the use of petroleum, makes products lighter, and uses agricultural waste that would otherwise be discarded. In theory, peanut shells could also make plastics stiffer and stronger, creating more sustainable plastic products.

However, there is a key problem. Peanut shells naturally absorb water, while plastics repel water. Because of this difference, the two materials do not stick together well. Poor bonding weakens the final product.

To improve this, we first ground the peanut shells into a fine powder so they would mix better with the plastic. We also tried chemical treatments:

- NaOH (alkali) treatment to clean and modify the shell surface
- MAPE, a special additive meant to help the shell bond with the plastic

We mixed these treated and untreated shells with high-density polyethylene (HDPE) and tested the strength and flexibility of the materials. What we found:

- Adding peanut shells made the plastic stiffer, but also weaker and more brittle (it stretched much less before breaking). - Adding MAPE did not noticeably improve the strength.
- NaOH treatment also showed little or no benefit.

Overall, peanut shells did not significantly improve the performance of HDPE under the conditions tested. Although the addition of peanut shells to HDPE does not increase the mechanical properties, the peanut shell fillers have the advantage of reducing the cost of HDPE; thus, for applications that can tolerate the reduced tensile and elongation, the use of peanut filler may be beneficial. In addition to the above results, we have gathered a lot more data on the effects of concentrations of filler and MAPE and hydrogen peroxide treatment. However, these treatments have not significantly improved HDPE properties.
Why still consider peanut shells? Even though strength decreases, peanut shells:

- Lower material cost
- Reduce plastic use
- Recycle agricultural waste
- Improve sustainability

Therefore, for products that do not need high strength (such as low-stress or disposable items), peanut shell fillers may still be useful and economical.

The project has slowed because of staff reductions and a government shutdown. Even so, the work is continuing. Based on what we have learned, we are developing a new and improved method that we plan to test next year.

Atanu Biswas – Report on Use of Peanut Shell Peanuts Shells as Reinforcement for Polyolefin Composites, 1/28/26

Peanut shells are incorporated into plastics as a low-cost, eco-friendly natural filler. They reduce material costs, utilize agricultural waste, lower petroleum consumption, decrease product weight, and can improve stiffness and strength. As a result, they offer a pathway toward cheaper and more sustainable composite plastics. However, a major challenge is poor compatibility between the hydrophilic peanut shell particles and hydrophobic polymer matrices, which leads to weak interfacial bonding and compromised mechanical performance. To address this, we first ground the peanut shells into a fine powder to improve dispersion and processability. While grinding enhances mixing, it does not fully resolve commercialization issues because residual moisture and the inherently hydrophilic surface still cause swelling and poor adhesion to the polymer. In this work, we employed alkali treatment (to remove some hemicellulose and lignin) and maleated polyethylene (MAPE), hopefully to improve interfacial bonding.

An example of the data generated is shown in Table 1. We used high density polyethylene (HDPE) as the polyolefin. Peanut shell was milled and sieved to produce four particle size. Part of it was treatment with NaOH. The mechanical testing data for six HDPE samples with additions of MAPE, peanut shell, and/or NaOH-treated peanut shell are shown in Table 1.

Compared to HDPE, the addition of peanut shell (sample 3) reduces both the tensile strength and the elongation at break; the yield modulus increases. When MAPE is added to HDPE/peanut shell (sample 4 versus sample 3), no significant improvement is observed. A comparison of samples 3 and 5 shows no substantial improvement, indicating that NaOH treatment is probably not effective. A comparison of samples 4 and 6 confirms this observation.

Table 1. Mechanical Data on Composites of HDPE, MAPE, and Peanut Shells

No.	Sample	Tensile at yield, MPa	Elongation at yield, %	Tensile strength MPa	Elongation at break, %	Yield modulus, M PA
1	HDPE Control	25.1	10.3	25.1	167	523
2	HDPE/MAPE	29	9.3	29	125	758
3	HDPE/Peanut Shell	20.8	3.8	18.8	4	874
4	HDPE/MAPE and Peanut Shell	16.9	3.8	20.1	4.4	689
5	HDPE/Peanut Shell (NaOH)	16.3	2.8	16.3	2.9	1050
6	HDPE/MAPE and Peanut Shell (NaOH)	--	--	20.1	3.4on	839

Although the addition of peanut shell to HDPE does not increase the mechanical properties, the filler does have the advantage of reducing the cost of HDPE; thus, for applications that can tolerate the reduced tensile and elongation, the use of peanut filler may be beneficial. In addition to the above results, we have gathered a lot more data on the effects of concentrations of filler and MAPE and hydrogen peroxide treatment. However, these treatments have not significantly improved HDPE properties. This work is ongoing, but unfortunately has slowed down because of the loss of some technicians assigned to this project (due to federal employment downsizing) and later in the year (due to government shutdown). We plan to continue this work and complete this project. It may be noted that through our experience in this project we have developed an improved approach, which we will plan to propose for next year.