The process of converting polyethylene plastic waste to polyethylene wax

Abstract

The process of converting polyethylene plastic waste to polyethylene wax is studied here. In one embodiment, a method for converting a waste plastic to wax includes introducing the waste plastic into a chamber and adding hydrogen to the chamber. The method includes heating the waste plastic and hydrogen sufficiently to thermally depolymerize the waste plastic to form a wax product comprising paraffin and olefin compound. The effect of the reaction conditions—including pyrolysis temperature, pyrolysis time, and the content of the additive—on the yield and quality of the PE wax—such as penetration degree and melting point—are discussed. The PE wax obtained has a melting point of 104–144°C. The penetration degree is 0.1–42.4 mm; the yield of PE wax is over 90%

Keywords: polyethylene plastic waste , polyethylene wax

Hypotheses and claims

1. one way for converting a waste plastic to wax, the method comprising the steps of: introducing the waste plastic into a chamber; adding hydrogen to the chamber; heating the waste plastic and hydrogen sufficiently to thermally depolymerize the waste plastic to form a wax product comprising paraffin and olefin compounds.

2. The method of claim 1 further comprising providing the chamber with a depolymerization catalyst selected from solid acid catalysts, liquid acid catalysts, radical initiators, hydrogenation catalysts, zeolites, and catalysts on supports.

3. The method of claim 1 wherein heating the waste plastic and hydrogen comprises forming a polyethylene wax product comprising paraffin and olefin compounds in a paraffin:olefin ratio of at least about 1.1:1 and having a weight average molecular weight of from about 5000 gram per mole (g/mol) to about 15000 g/mol.

4. The method of claim 1 wherein heating the waste plastic and hydrogen comprises forming a polyethylene wax product comprising paraffin and olefin compounds in a paraffin:olefin ratio of at least about 1.1:1 and having a weight average molecular weight of from about 5000 gram per mole (g/mol) to about 15000 g/mol.

5. The method of claim 1 wherein introducing the waste plastic into a chamber comprises introducing the waste plastic to a chamber in a batch process

6. The method of claim 1 wherein hydrogen is added to the chamber after the waste plastic is introduced into the chamber

7. A method for converting a plastic to wax, the method comprising the steps of: contacting the plastic with hydrogen; and heating the plastic and the hydrogen sufficiently to thermally degrade the plastic to form a wax product with a Saybolt color (ASTM D156) of at least about **0.**

8. The method of claim 7 wherein heating the plastic and the hydrogen sufficiently to thermally degrade the plastic comprises forming the wax product with a Saybolt color (ASTM D156) of at least about +20

9. The method of claim 7 wherein heating the plastic and the hydrogen comprises thermally degrading the plastic to form a wax product having an average molecular weight of from about 5000 gram per mole (g/mol) to about 15000 g/mol

10. The method of claim 7 wherein heating the plastic and the hydrogen comprises thermally degrading the plastic to form a wax product having an average molecular weight of from about 6000 gram per mole (g/mol) to about 9000 g/mol

11. The method of claim 7 wherein heating the plastic and the hydrogen comprises thermally degrading the plastic to form a wax product comprising paraffin and olefin compounds in a paraffin:olefin ratio of at least about 1.1:1.

12. The method of claim 7 wherein heating the plastic and the hydrogen comprises heating the plastic and the hydrogen to a temperature of about 300.degree. C. to about 500.degree. C

13. The method of claim 7 further comprising melting the plastic before contacting the plastic with hydrogen

14. The method of claim 7 further comprising melting the plastic after contacting the plastic with hydrogen

15. The method of claim 7 further comprising melting the plastic at a temperature of about **100.**degree. C. to about **150.**degree. C.

16. The method of claim 7 further comprising agitating the plastic after contacting the plastic with hydrogen to promote dissolution of the hydrogen into the plastic

17. The method of claim 7 wherein contacting the plastic with hydrogen comprises locating the plastic in a hydrogen environment, and wherein the method further comprises maintaining a hydrogen partial pressure in the hydrogen environment of at least about 0.5 atmospheres (atm)

18. The method of claim 7 wherein contacting the plastic with hydrogen comprises: introducing the plastic to a chamber; and filling the chamber with the hydrogen and an inert gas.

19. The method of claim 7 wherein contacting the plastic with hydrogen comprises locating the plastic in an environment comprising substantially pure hydrogen

20. A method for converting waste plastic to polyethylene wax, the method comprising the steps of: melting the waste plastic; dissolving hydrogen into the waste plastic; and thermally depolymerizing the waste plastic in the presence of the hydrogen to form a polyethylene wax product comprising paraffin and olefin compounds

Description:

Waxes are broadly divided into several well established groups including paraffin waxes (normally obtained from petroleum oil lubricating distillates), microcrystalline wax (usually obtained from residual lubricating oil fractions), and polyethylene waxes (typically manufactured from low molecular weight, high-density raw materials). Each of these wax types has been found to have specific physical properties making them especially attractive for particular utilities. For example, polyethylene waxes are often used in the formulation of colorants for plastics, in polyvinyl chloride lubricants, in adhesives, and in inks to decrease friction. Polyethylene waxes may further be used as release agents or as slip .agents

Polyethylene wax compositions contain a variety of polyethylenes. For the most part, polyethylenes employed in polyethylene waxes have weight average molecular weights in the range of about 1500 grams per mole (g/mol) to about 20,000 g/mol. High grade polyethylene waxes may be obtained by the controlled polymerization of ethylene to obtain desired properties such as molecular weight, melting point, viscosity and hardness. Recently, there has been a rise in the use of lower grade polyethylene waxes that are typically derived from the thermal decomposition of polyethylene resin. Such lower grade products have become popular for use in application or locations where product quality is secondary to cost. However, polyethylene waxes derived from the thermal decomposition of polyethylene resin are typically inferior in quality, e.g., they exhibit undesirable color, low molecular .weight, and are inconsistent across production lots

Accordingly, it is desirable to provide a low cost method for producing polyethylene wax with improved properties. Further, it is desirable to provide a method for converting waste plastic into wax with desired properties. Furthermore, other desirable features and characteristics will become apparent from the subsequent detailed description and the appended claims, taken in conjunction with the accompanying drawings and the foregoing technical field and background.

BRIEF SUMMARY:

Methods for converting plastic to wax are provided. In an exemplary embodiment, a method for converting a waste plastic to wax includes introducing the waste plastic into a chamber and adding hydrogen to the chamber. The method includes heating the waste plastic and hydrogen sufficiently to thermally depolymerize the waste plastic to form a wax product comprising paraffin and olefin compounds.

In another embodiment, a method for converting plastic to wax includes contacting the plastic with hydrogen. Further, the method includes heating the plastic and the hydrogen sufficiently to thermally degrade the plastic to form a wax product with a Saybolt color (ASTM D156) of at least about 0

In another embodiment, a method is provided for converting waste plastic to polyethylene wax. The method includes melting the waste plastic. Hydrogen is dissolved into the waste plastic. The waste plastic is thermally depolymerized in the presence of the hydrogen to form a polyethylene wax product comprising paraffin and olefin compounds

Resources:

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