AN OVERVIEW ON SYNTHETIC METHODS OF N-BUTYL ACETATE

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Nowadays a few synthetic methods of n-butyl acetate using different catalysts such as inorganic salt like (Ce(SO₄)₂), FeNH₄(SO₄)₂⋅12H₂O, LaSO₄/SiO₂, KHSO₄ and SnCl₃/C, HZSM-5, oxide (MoO₃/SiO₂), I₂, heteropolyacid (H₃(PO₃/2O₆)nH₂O), quaternary ammonium salt ionic liquid and nanometer ZnO have been reviewed. The yields of n-butyl acetate are improved by the addition of above catalysts. These methods are having the advantages of simple process and low investment costs.

Introduction

n-Butyl acetate is one of the colourless flammable liquids. It is used as a synthetic flavour agent in food products and/or as a solvent in the production of lacquers, plastic or artificial leather.¹ n-Butyl acetate and other organic solvent such as alcohol, aldehyde, ester, etc. are completely miscible in all proportions. Natural n-butyl acetate exists in apple, banana, cherry and grape fruits. It is easily evaporated and hard to dissolve in water. Furthermore, it can dissolve brain grease, gum and rosin. It has anaesthetic and pungent in character. Its specific gravity d₂⁰, refractive index n₂⁰ and boiling point are 0.8825, 1.3941 and 126.1 °C, respectively.²

In the present paper, different catalysts such as inorganic salt (Ce(SO₄)₂), NH₄Fe(SO₄)₂⋅12H₂O, LaSO₄/SiO₂, KHSO₄ and SnCl₃/C, HZSM-5, oxide (MoO₃/SiO₂), I₂, heteropolyacid (H₃(PO₃/2O₆)nH₂O), quaternary ammonium salt ionic liquid and nanometer ZnO have been discussed.

DISCUSSION

Ce(SO₄)₂-SBA-15 as a catalyst to produce n-butyl acetate

Yin Yanlei ³ introduced the preparation of n-butyl acetate and the effect of the reaction conditions on its yield. Ce(SO₄)₂ and SBA-15 as catalysts were ground and roasted to produce n-butyl acetate. The optimum conditions were the reaction time (2 hours) and molar ratio of acetic acid to n-butanol (1.0:1.2), amount of catalyst (0.0375g) respectively. The maximum yield of n-butyl acetate was 95.13%. The experimental results showed that Ce(SO₄)₂ and SBA-15 had good catalytic performance and were reused several times.

NH₄Fe(SO₄)₂⋅12H₂O as a catalyst to generate n-butyl acetate

Kong Xiangwen ⁴ explained why NH₄Fe(SO₄)₂⋅12H₂O as a catalyst took the place of concentrated sulfuric acid to generate n-butyl acetate. The effect of the reaction conditions such as the reaction time, molar ratio of acetic acid to n-butanol and amount of catalyst had been discussed. The experimental results represented that the best conditions were that the reaction time, molar ratio of acetic acid to n-butanol and amount of catalyst were 0.75 hours, 1.0:1.2 and 1.1 g, respectively. The maximum yield of n-butyl acetate was 98.5%.

LaSO₄/SiO₂ as a catalyst to produce n-butyl acetate

Song Jianguo ⁵ described the synthetic method of n-butyl acetate by using LaSO₄/SiO₂ as catalysts. The effect of the reaction conditions such as the reaction time, molar ratio of acetic acid to n-butanol, amount of catalyst and number of reusable catalyst had been discussed. The best conditions were that the reaction time, molar ratio of acetic acid to n-butanol and amount of catalyst were 2 hours, 1.0:1.3 and 0.06 g, respectively. The maximum yield of n-butyl acetate was 95.2%. After recovery and reuse of LaSO₄/SiO₂ as a catalyst it was noticed that its catalytic performance was very poor. For example, when LaSO₄/SiO₂ were reused 5 times, the yield of n-butyl acetate only reached 56.3%.

KHSO₄ as a catalyst to generate n-butyl acetate

Cai Xin’an ⁶ used KHSO₄ as a catalyst to produce n-butyl acetate. The effect of the reaction conditions such as amount of n-butanol, molar ratio of acetic acid to n-butanol and amount of catalyst had been discussed. The best conditions were that amount of n-butanol, molar ratio of acetic acid to n-butanol and amount of catalyst were 0.25 mol, 1.0:1.3 and 1.15 g, respectively. The maximum yield of n-butyl acetate was 86.83%.

SnCl₃/C as a catalyst to produce n-butyl acetate

Li Jiagu ⁷ described the synthetic method of n-butyl acetate by using SnCl₃/C as catalysts. The effect of the reaction conditions such as amount of acetic acid, molar ratio of acetic acid to n-butanol, amount of catalyst and number of reusable catalyst had been discussed. The best conditions were that amount of acetic acid, molar ratio of acetic acid to n-butanol and amount of catalyst were 0.1 mol, 1.0:2.2 and 0.15 g, respectively. The maximum yield of n-butyl acetate was 94.8%. When SnCl₃/C as catalysts were recovered and reused, their catalytic
performance was found to be very good. For example, when SnCl\textsubscript{2}/C were reused 5 times, the yield of n-butyle acetate still reached 90.1%.

**HZSM-5 as a catalyst to generate n-butyl acetate**

Li Minghui\textsuperscript{9} introduced the preparation of HZSM-5 and the effect of the reaction conditions such as the reaction time, molar ratio of acetic acid to n-butanol and amount of catalyst on the yield of n-butyl acetate. The best conditions were that the reaction time, molar ratio of acetic acid to n-butanol and amount of catalyst were 1 hour, 1:0:1.1 and 0.5 g, respectively. The maximum yield of n-butyl acetate was 94.0%.

**MoO\textsubscript{3}/SiO\textsubscript{2} as a catalyst to produce n-butyl acetate**

Li Shuchang\textsuperscript{9} described the preparation of MoO\textsubscript{3}/SiO\textsubscript{2} and the effect of the reaction conditions such as the reaction time, molar ratio of acetic acid to n-butanol, amount of catalyst and number of reusable catalyst on the yield of n-butyl acetate. The best conditions were that the reaction time, molar ratio of acetic acid to n-butanol and amount of catalyst were 3 hours, 1:0:4.0 and 1.0 g, respectively. The maximum yield of n-butyl acetate was 95.6%. When MoO\textsubscript{3}/SiO\textsubscript{2} as catalysts were recovered and reused, their catalytic performance was perfect. For example, when MoO\textsubscript{3}/SiO\textsubscript{2} were reused 5 times, the yield of n-butyle acetate still arrived at 95.2%.

**I\textsubscript{2} as a catalyst to generate n-butyl acetate**

Jiang Hongbo \textsuperscript{10} used I\textsubscript{2} as a catalyst to generate n-butyl acetate. The effect of the reaction conditions such as the reaction time, molar ratio of acetic acid to n-butanol and amount of catalyst had been discussed. The best conditions were that the reaction time, molar ratio of acetic acid to n-butanol and amount of catalyst were 4.0 hours, 1.5:1.0 and 0.6 g, respectively. The maximum yield of n-butyl acetate was 67.52%.

**H\textsubscript{3}(PW\textsubscript{12}O\textsubscript{40})\cdot nH\textsubscript{2}O as a catalyst to produce n-butyl acetate**

Li Guixian\textsuperscript{11} introduced the preparation of H\textsubscript{3}(PW\textsubscript{12}O\textsubscript{40})\cdot nH\textsubscript{2}O with attapulgite and the effect of the reaction conditions such as the reaction time, molar ratio of acetic acid to n-butanol, amount of catalyst and number of usable catalyst on the yield of n-butyl acetate. The best conditions were that the reaction time, molar ratio of acetic acid to n-butanol and amount of catalyst were 2.5 hours, 1:0:2.5 and 0.1580 g, respectively. The maximum yield of n-butyl acetate was 94.0%. When H\textsubscript{3}(PW\textsubscript{12}O\textsubscript{40})\cdot nH\textsubscript{2}O as a catalyst was recovered and reused, its catalytic performance was poor. For example, after used 5 times as catalyst, H\textsubscript{3}(PW\textsubscript{12}O\textsubscript{40})\cdot nH\textsubscript{2}O, the yield of n-butyl acetate reached only to 77.98%.

**Quaternary ammonium salt ionic liquid as a catalyst to generate n-butyl acetate**

Li Wenjun\textsuperscript{12} described the preparation of four types of quaternary ammonium salt ionic liquids such as [Et\textsubscript{3}NH][HSO\textsubscript{4}], [Et\textsubscript{3}NH][H\textsubscript{2}SO\textsubscript{4}], [n-Pro\textsubscript{3}NH][HSO\textsubscript{4}] and [n-But\textsubscript{3}NH][HSO\textsubscript{4}]. He used [Et\textsubscript{3}NH][HSO\textsubscript{4}] as a catalyst to generate n-butyl acetate. The effect of the reaction conditions such as the reaction time, molar ratio of acetic acid to n-butanol and molar ratio of [Et\textsubscript{3}NH][HSO\textsubscript{4}] to n-butanol had been discussed. The best conditions were that the reaction time, molar ratio of acetic acid to n-butanol and molar ratio of [Et\textsubscript{3}NH][HSO\textsubscript{4}] to n-butanol were 8.0 hours, 2.0:1.0 and 1.0:4.0, respectively. The maximum yield of n-butyl acetate was 81.94%.

**Nanometer ZnO as a catalyst to produce n-butyl acetate**

Lai Wenzhong\textsuperscript{13} used nanometer ZnO as a catalyst and acetic acid to n-butanol as feedstocks to produce n-butyl acetate. The effect of the reaction conditions such as the reaction time, molar ratio of acetic acid to n-butanol and amount of catalyst on the yield of n-butyl acetate had been discussed. The best conditions were that the reaction time, molar ratio of acetic acid to n-butanol and amount of catalyst were 3.0 hours, 1:0:2.0 and 0.80 g, respectively. The maximum yield of n-butyl acetate was 86.72%.

**CONCLUSION**

Based on the above discussion and review, NH\textsubscript{4}Fe(SO\textsubscript{4})\textsubscript{2}·12H\textsubscript{2}O that is one of the best catalysts is used to produce n-butyl acetate because it is very cheap, stable and insoluble in organic acids and organic alcohol. After the reaction is done, NH\textsubscript{4}Fe(SO\textsubscript{4})\textsubscript{2}·12H\textsubscript{2}O becomes insoluble material and is easily separated from the reaction system. It has high performance catalytic and selectivity and non-corrosive. However, I\textsubscript{2} is one of the worst catalysts and its maximum yield of n-butyl acetate only reaches 67.52%.

**REFERENCES**


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