AN OVERVIEW ON SYNTHETIC METHODS OF ISOAMYL BENZOATE

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A few of synthetic methods of isoamyl benzoate using different catalysts such as sulfonic acid (p-toluene-sulfonic acid and aryl sulphonic acid), inorganic salt ($NH_4Fe(SO_4)_2{\cdot}12H_2O$, $NaHSO_4{\cdot}H_2O$, $Fe_2(SO_4)_3{\cdot}xH_2O$ and $FeCl_3{\cdot}6H_2O$), heteropolyacid ($H_4O_{40}W_{12}$ and $TiSiW_{12}O_{40}/TiO_2$) and solid super acid ($Ti(SO_4)_2/TiO_2$ and $Zr(SO_4)_2{\cdot}4H_2O$) have been discussed in the present paper. The yields of isoamyl benzoate have been improved by the addition of above catalysts. Due to simple process and low investment cost these methods are having an advantage over other conventional methods.

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INTRODUCTION

Isoamyl benzoate is not only a colourless liquid of fruit aroma but also one of the important chemical products.[1] Due to floral fragrance, it is widely used in different areas such as daily use chemical essence as a mobilizing agent for fragrance, type fragrance as a fixative for a white-tip clover or an orchid, food flavours as a mobilizing agent for apples, peaches, plums, almonds and cherries, etc.[2] It is also used as a solvent for fats or resins. Benzoic acid with concentrated sulphuric acid as a catalyst reacts with isoamyl alcohol to produce isoamyl benzoate, used in industry as manufacturing process. This method has a lot of disadvantages such as poor quality of products, serious equipment corrosion, complicated operating system and environmental pollution issues, etc. [3]

In the present paper, a new class of catalysts such as sulfonic acid (p-toluene-sulfonic acid and aryl sulphonic acid), inorganic salt ($NH_4Fe(SO_4)_2{\cdot}12H_2O$, $NaHSO_4{\cdot}H_2O$, $Fe_2(SO_4)_3{\cdot}xH_2O$ and $FeCl_3{\cdot}6H_2O$), heteropolyacid ($H_4O_{40}W_{12}$ and $TiSiW_{12}O_{40}/TiO_2$) and solid super acid ($Ti(SO_4)_2/TiO_2$ and $Zr(SO_4)_2{\cdot}4H_2O$) have been discussed.

DISCUSSION

Sulfonic acid as a catalyst to produce isoamyl benzoate

Ding Liangzhong[4] introduced the effect of the reaction conditions on the yield of isoamyl benzoate. Using p-toluene-sulfonic acid as a catalyst and benzoic acid and isoamyl alcohol as feedstocks produced isoamyl benzoate. The optimum conditions were the molar ratio of benzoic acid to isoamyl alcohol (1.0:3.0), the reaction time (2.5 hours) and the amount of p-toluene-sulfonic acid (1.25 g) respectively. The maximum yield and purity of isoamyl benzoate were 88.3% and 94.4%, respectively. The experimental results showed that p-toluene-sulfonic acid had good catalytic performance and low prices and was easily available. Its equipment corrosion and environmental pollution of p-toluene-sulfonic acid were less than that of concentrated sulphuric acid. Furthermore, p-toluene-sulfonic acid was one of the better catalysts and occupied the place of concentrated sulphuric acid.

Li Xiuyu[5] described the synthetic method of isoamyl benzoate and studied that the different conditions had an effect on the yield of isoamyl benzoate. Aryl sulphonic acid (ASA) and benzoic acid and isoamyl alcohol used as a catalyst and feedstocks respectively generated isoamyl benzoate. The experimental results represented that the best conditions were that the reaction time, the molar ratio of benzoic acid to isoamyl alcohol and the amount of ASA were 2.0 hours, 1.0:2.0 and 0.73 g, respectively. The maximum yield of isoamyl benzoate was 98.35%. ASA used as a catalyst had good catalytic performance also.

Inorganic salt as a catalyst to generate isoamyl benzoate

Yu Shanxin[6] described the synthetic method of isoamyl benzoate by using $NH_4Fe(SO_4)_2{\cdot}12H_2O$ as a catalyst. The effect of the reaction conditions such as the reaction time, the molar ratio of benzoic acid to isoamyl alcohol, the amount of $NH_4Fe(SO_4)_2{\cdot}12H_2O$ had been discussed. The best conditions were that the reaction time, the molar ratio of benzoic acid to isoamyl alcohol, the amount of $NH_4Fe(SO_4)_2{\cdot}12H_2O$ were 4 hours, 1.0:2.0 and 4.0 g, respectively. The maximum yield of isoamyl benzoate was 82.3%.

Guang Shibin[7] explained why $NaHSO_4{\cdot}H_2O$ as a catalyst took the place of concentrated sulfuric acid to generate isoamyl benzoate. The effect of the reaction conditions such as the reaction time, the molar ratio of benzoic acid to isoamyl alcohol, the amount of $NaHSO_4{\cdot}H_2O$ had been discussed. The experimental results represented that the best conditions were the reaction time, the molar ratio of benzoic acid to isoamyl alcohol, the amount of $NaHSO_4{\cdot}H_2O$ were 3 hours, 1.0:6.0:5.0 and 1.50 g, respectively. The maximum yield of isoamyl benzoate was 94.8%. Furthermore, $NaHSO_4{\cdot}H_2O$ is very cheap, stable and insoluble in organic acids and organic alcohol, so it maybe is a good choice as a catalyst to produce isoamyl benzoate.

Liu Xinhe[8] described the synthetic method of isoamyl benzoate by using $Fe_2(SO_4)_3 \cdot xH_2O$ as a catalyst. The effect of the reaction conditions such as the reaction time, the molar ratio of benzoic acid to isoamyl alcohol and the amount of $Fe_2(SO_4)_3 \cdot xH_2O$ had been discussed. The best conditions were that the reaction time, the molar ratio of benzoic acid to isoamyl alcohol and the amount of $Fe_2(SO_4)_3 \cdot xH_2O$ were 3.0 hours, 1.0:3.0 and 0.49 g, respectively. The maximum yield and purity of isoamyl benzoate were 92.7% and 98.5%, respectively.

Zhang Hong [9] introduced the synthetic principle of isoamyl benzoate and the effect of the reaction conditions such as the reaction time, the molar ratio of benzoic acid to isoamyl alcohol and the amount of $FeCl_3 \cdot 6H_2O$ on the yield of isoamyl benzoate. The best conditions were that the reaction time, the molar ratio of benzoic acid to isoamyl alcohol and the amount of $FeCl_3 \cdot 6H_2O$ were 2.5 hours, 1.0:3.0 and 1.0 g, respectively. The maximum yield of isoamyl benzoate was 90.3%.

Heteropolyacid as a catalyst to produce isoamyl benzoate

Zhou Wenkai [10] introduced the preparation of $H_4O_{40}W_{12}$ and the effect of the reaction conditions such as the reaction time, the molar ratio of benzoic acid to isoamyl alcohol and the amount of $H_4O_{40}W_{12}$ on the yield of isoamyl benzoate. The best conditions were that the reaction time, the molar ratio of benzoic acid to isoamyl alcohol and the amount of $H_4O_{40}W_{12}$ were 1.5 hours, 1.0:1.5 and 0.18 g, respectively. The maximum yield of isoamyl benzoate was 78.0%.

Yang Shuijin [11] used $TiSiW_{12}O_{40}/TiO_2$ as a catalyst to produce isoamyl benzonate. The effect of the reaction conditions such as the reaction time, the reaction temperature, the molar ratio of benzoic acid to isoamyl alcohol and the amount of $TiSiW_{12}O_{40}/TiO_2$ had been discussed. The best conditions were the reaction time, the reaction temperature, the molar ratio of benzoic acid to isoamyl alcohol and the amount of $TiSiW_{12}O_{40}/TiO_2$ were 2.5 hours, 140 - 148°C, 1.0:4.0 and 5.93 g, respectively. The maximum yield of isoamyl benzonate was 83.3%.

Solid super acid as a catalyst to generate isoamyl benzoate

Zhang Fujuan [3] used $Ti(SO_4)_2/TiO_2$ as a catalyst to generate isoamyl benzoate. The effect of the reaction conditions such as the reaction time, the molar ratio of benzoic acid to isoamyl alcohol and the amount of $Ti(SO_4)_2/TiO_2$ had been discussed. The best conditions were that the reaction time, the molar ratio of benzoic acid to isoamyl alcohol and the amount of $Ti(SO_4)_2/TiO_2$ were 1.5 hours, 1.0:4.0 and 2.5 g, respectively. The maximum yield of isoamyl benzoate was 96.6%.

Zhang Fuxing [12] used $Zr(SO_4)_2 \cdot 4H_2O$ as a catalyst and benzoic acid and isoamyl alcohol as feedstocks to produce isoamyl benzoate. The effect of the reaction conditions such as the reaction time, the molar ratio of benzoic acid to isoamyl alcohol and the amount of $Zr(SO_4)_2 \cdot 4H_2O$ on the yield of isoamyl benzoate had been discussed. The best conditions were that the reaction time, the molar ratio of benzoic acid to isoamyl alcohol and the amount of $Zr(SO_4)_2 \cdot 4H_2O$ were 2.5 hours, 1.0:2.5 and 0.4 g, respectively. The highest yield of isoamyl benzoate was 96.3%.

CONCLUSION

Based on the above discussion and review, aryl sulphonic acid (ASA) is one of the best catalysts. It is used to produce the highest yields of isoamyl benzoate (98.35%). On the other hand, $H_4O_{40}W_{12}$ is one of the worst catalysts and its maximum yield of isoamyl benzoate only reaches 78.0%.

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