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An overview on synthetic methods of isoamyl acetate

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ABSTRACT

Synthetic methods of isoamyl acetateusing different catalysts such as sulfonic acid (dodecylbenzenesulfonicacid and dimethyl-benzenesulfonic acid with the microwave heating method),inorganic salts ($FeCl_3$-$6H_2O$, $FeCl_3$with the microwave heating method, $AlCl_3$with the microwave heating method and Ti $(SO_4)_2$/carbon) and solid super acid (SO_4^{2-}/Fe_2O_3 and $S_2O_8^{2-}/Fe_2O_3/ZnO/ZrO_2$) have also been discussed.

KEYWORDS

Overview;
Synthetic methods;
Isoamyl acetate.

INTRODUCTION

Isoamyl acetateis a colorless liquid with a pleasantly fruity odor. Its molecularformula and boiling point are $C_7H_{14}O_2$ and 140 °C, respectively. Isoamyl acetate is hard to dissolve in water (0.25%), but dissolves in organic solvents, such as diethyl ether, alcohol, ethyl acetate and mineral oil, etc. Isoamyl acetate is naturally found in many fruits such as apples, bananas, grapes, peaches, pear and strawberries, etc[1]. It is also one of the important organic products. Due to floral fragrance, it is widely used in different areas such as cigarette and alcohol as essences, spray paint, varnish, nitrocellulose, chloroprenerubberand printing ink as solvents, etc[2]. Isoamylalcohol with concentrated sulphuric acid as a catalyst reacts with acetic acid to synthesize isoamyl acetate. Concentrated sulphuric acid has a lot of disadvantages also except several advantages, such as long reaction time, low yield and purity of isoamyl acetate. Large amount of waste water is discharged to cause the problem of environmental pollution and equipments are seriously corroded at the same time[3].

In the present paper, synthetic methods of isoamyl acetate using different catalysts such as sulfonic acid (dodecylbenzenesulfonicacid and dimethyl-benzenesulfonic acidwith the microwave heating method), inorganic salts ($FeCl_3$-$6H_2O$, $FeCl_3$ with the microwave heating method, $AlCl_3$with the microwave heating method and Ti $(SO_4)_2$/carbon) and solid super acid (SO_4^{2-}/Fe_2O_3 and $S_2O_8^{2-}/Fe_2O_3/ZnO/ZrO_2$) have also been introduced.

RESULTS AND DISCUSSION

Dodecylbenzenesulfonicacidas a catalyst

Ma Songyan[4] used dodecylbenzenesulfonic acid as the catalyst to synthesise isoamyl acetate from acetic acid and isoamylalcohol. The optimal conditions were the molar ratio of acetic acid to isoamyl alcohol (1.0 : 4.0), the reaction time (4hr), the reaction temperature (45 °C) and the weight ratio of dodecylbenzenesulfonic acid to acetic acid (5.0 %) respectively. The maximum yield of isoamyl acetate was 81.57 %.

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Dimethyl-benzenesulfonic acidas a catalyst with the microwave heating method

Liu Hong[5] described a synthesis usingdimethyl-benzenesulfonic acid as the catalyst with the microwave heating method. The optimal conditions were the reaction time (10 min), the molar ratio of acetic acid to isoamyl alcohol (2.0 : 1.0), the weight ratio of dimethyl-benzenesulfonic acid to acetic acid (7.5 %) and the microwave power (400 W) respectively. The maximum yield of isoamyl acetate was 95.7 %.

$FeCl_3 \cdot 6H_2O$ as a catalyst

Liu Xiaozhong[6] used $FeCl_3 \cdot 6H_2O$to study on the synthesis of isoamyl acetate. The optimal reaction conditions were: the reaction time (1 hr), the molar ratio of acetic acid to isoamylalcohol (1.0 : 2.6), the weight ratio of $FeCl_3 \cdot 6H_2O$ to acetic acid (1.18 %) respectively. The maximum yield of isoamyl acetate was 90.04 %.

$FeCl_3$ as a catalystwith the microwave heating method

Li Li[7] described the synthesis of isoamyl acetate and used $FeCl_3$ as the catalyst. The optimal conditions were: the reaction time (25 min), the molar ratio of acetic acid to isoamyl alcohol (1.0 : 1.4) and the weight ratio of $FeCl_3$ to acetic acid (6.67 %) respectively. The maximum yield of isoamyl acetate was 82.1 %.

$AlCl_3$ as a catalyst with the microwave heating method

Long Jinqiao[8] used $AlCl_3$ as the catalyst with the microwave heating method to synthesize isoamyl acetate. The optimal microwave heating time (10 min), the microwave heating power (700 W), the molar ratio of acetic acid to isoamylalcohol (1.0 : 2.5) and the weight ratio of $AlCl_3$ to total reactant (8.5 %) were introduced. The maximum yield of isoamyl acetate was 92.9 %.

$Ti(SO_4)_2$/carbon as a catalyst

PengWangming[9] used $Ti(SO_4)_2$/carbon as the catalyst and explained the reasons for its use. The optimal reaction conditions were: the reaction time (2.5 hr), the reaction temperature (120 °C), the molar ratio of acetic acid to isoamylalcohol (2.5 : 1.0), the weight ratio of $Ti(SO_4)_2$ to carbon (3.0 : 1.0) and the weight ratio of $Ti(SO_4)_2$/carbon to acetic acid (2.95%) respectively. The maximum yield of isoamyl acetate was 93.86 %.

SO_4^{2-}/Fe_2O_3 as a catalyst

WangQihui[3] described how to prepare SO_4^{2-}/Fe_2O_3 and introduced the synthesis of isoamyl acetate by using SO_4^{2-}/Fe_2O_3as the catalyst. The optimal reaction time (2hr), the molar ratio of acetic acid to isoamyl alcohol (1.0 : 2.5), the weight ratio of SO_4^{2-}/Fe_2O_3 to acetic acid (6.67 %) were mentioned. The maximum yield of isoamyl acetate was 87.4 %.

$S_2O_8^{2-}/Fe_2O_3/ZnO/ZrO_2$ as a catalyst

DuYaqin[10] described the synthesis of $S_2O_8^{2-}/Fe_2O_3/ZnO/ZrO_2$and isoamyl acetate. The optimal reaction conditions were: the calcination temperature (650 °C), the calcination time (3.0 hr), the reaction temperature (80 °C), the reaction time (50 min), the molar ratio of acetic acid to isoamyl alcohol (1.0 : 2.0) and the weight ratio of $S_2O_8^{2-}/Fe_2O_3/ZnO/ZrO_2$ to acetic acid (7.41 %) respectively. The maximum yield of isoamyl acetate was 88.5 %.

CONCLUSION

Based on the above discussion and review, dimethyl-benzenesulfonic acidis one of the best catalysts for the highest yield of isoamyl acetate (95.7 %). On the other hand, dodecylbenzenesulfonic acidis the worst of the catalysts since the maximum yield of isoamyl acetate was only 81.57%.

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