Improving the Oxidative Stability and Low Temperature Fluidity of Biodiesel by the Compound Improvers

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ABSTRACT

Improvement of the oxidative stability and low temperature flow characteristics of biodiesel still remains two of the major challenges. Four biodiesel samples were prepared from rapeseed oil, soybean oil, palm oil and waste frying oil. The composition and content of the fatty acids, oxidative stability and low temperature fluidity of the samples were analyzed. The compound improvers consist of antioxidants and cold flow improvers. The effects of the compound improvers on the oxidative stability and low temperature fluidity of biodiesel were investigated. The results showed that the mixture improvers had positive synergic effect on improving the induction period (IP) and cold filter plugging point (CFPP) of the fatty acid methyl esters, especially in decreasing the CFPP of the biodiesel from palm oil and waste frying oil.

Materials

- Bio-J801, Bio-J802, Bio-J803, Bio-J804, Bio-J805, Bio-JM801, Bio-JP801, BI-P100, and BI-W100 were obtained from the antioxidants and cold flow improvers
- The antioxidants were purchased from Taiban Companyand the cold flow improvers were supplied by Bingling Company and Renying Company
- MMAmS (cold flow improver) was synthesized in the lab
- All reagents were of analytical grade.

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Methods

Transesterification reaction was carried out in a spherical glass reactor equipped with reflux condenser, stirrer and thermometer. The compound improvers were prepared in a 500ml-glass reactor equipped with stirrer and thermometer. The antioxidants were first dissolved by a oil-solubility solvent, and heated at 40℃ for 10min. The cold flow improvers were added into the reactor by stirring.

The synthesis of MMAmS was carried out in a 1000ml- glass reactor equipped with reflux condenser, stirrer, and thermometer and nitrogen pipe. The ester mixture was first dissolved in toluene with nitrogen, and heated by keeping stirring. An initiator was added into the mixture at reaction temperature. The solvent was distilled after the reaction.

Result

Table 1 Chemical and physical properties of biodiesel samples

	RME	WFME	SME	PME
Density（20℃）/（kg/m3）	885	879	877	873
Viscosity/40℃/mm2/s	5.64	5.27	4.49	4.63
Flash point/℃	136	131	134	134
CFPP/℃	-11	10	-2	7
Water content/%	0.03	0.04	0.03	0.02
Copper strip corrosion/50℃,3h	1	1	1	1
Acid number /(mgKOH/g)	0.7	1.2	0.6	0.6
Induction period/110℃，h	7.16	0.18	0.6	19.93

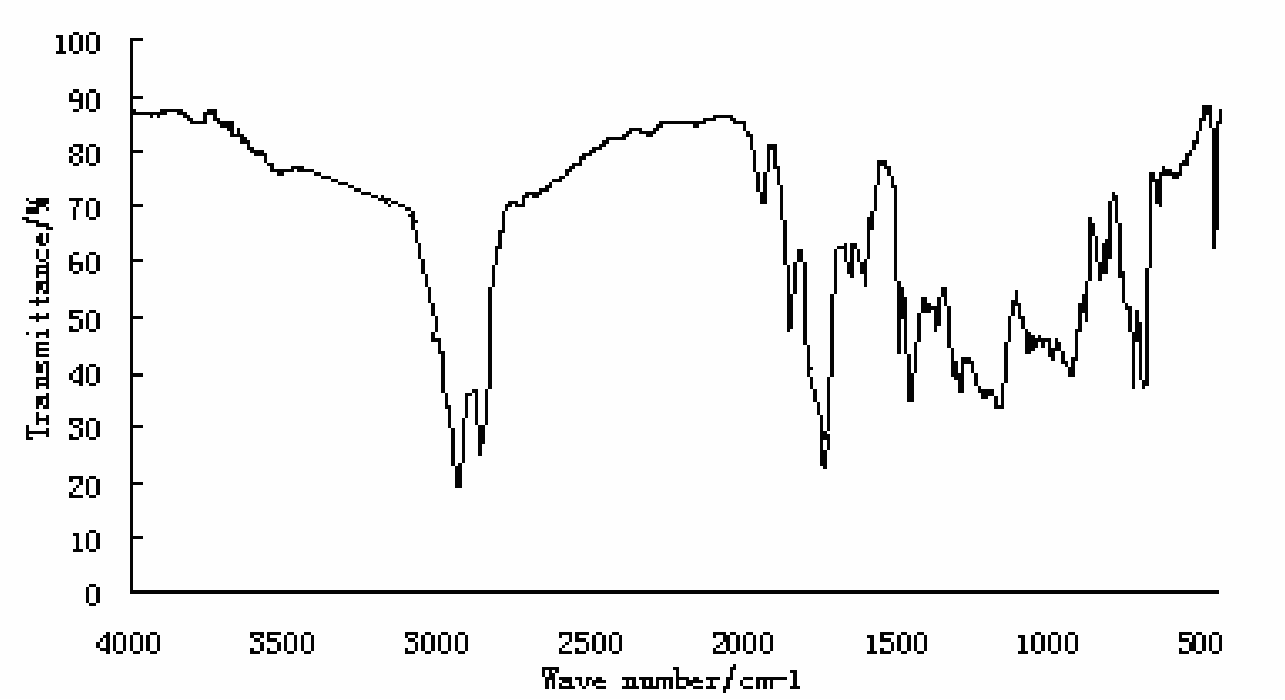

Fig 1. Infrared spectrogram of copolymers MMAmS

Table 2 Effects of the compound improvers on IP and CFPP of RME

Compound improvers	Addition level	IP，△h	CFPP，△℃
Bio-J801	0.10%	4.42	3
	0.30%	3.47	4
	0.50%	3.63	4
Bio-J802	0.10%	1.87	9
	0.30%	1.8	8
	0.50%	1.63	5
Bio-J803	0.10%	1.56	10
	0.30%	2.76	8
	0.50%	4.01	7
Bio-J804	0.10%	2.42	5
	0.30%	2.21	5
	0.50%	2.22	6
Bio-J805	0.10%	1.08	6
	0.30%	2.4	5
	0.50%	2.63	7
BI-JM100	0.10%	2.42	10
	0.30%	2.18	9
	0.50%	2.11	9

Table 3 Effects of the compound improvers on IP and CFPP of SME

Compound improvers	Addition level	IP，△h	CFPP，△℃
Bio-J801	0.10%	10.18	3
	0.30%	9.5	6
	0.50%	9.64	8
Bio-J802	0.10%	6.99	2
	0.30%	9.16	4
	0.50%	7.6	4
Bio-J803	0.10%	9.2	3
	0.30%	10.4	4
	0.50%	9.9	5
Bio-J804	0.10%	6.7	2
	0.30%	7.16	5
	0.50%	7.95	5
Bio-J805	0.10%	7.61	3
	0.30%	9.2	4
	0.50%	9.7	6
BI-JP100	0.10%	10.17	7
	0.30%	10.25	5
	0.50%	10.16	6

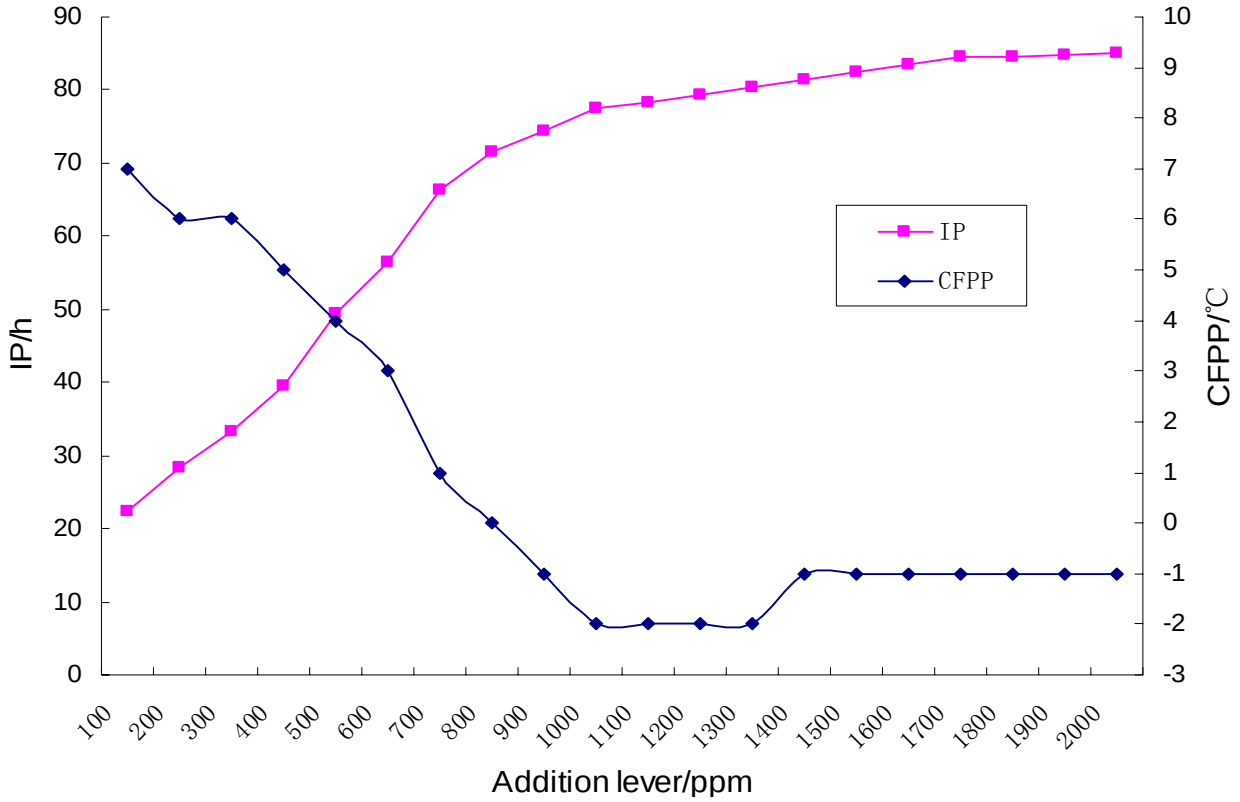

Fig 2. Effects of BI-P100 on IP and CFPP of PME

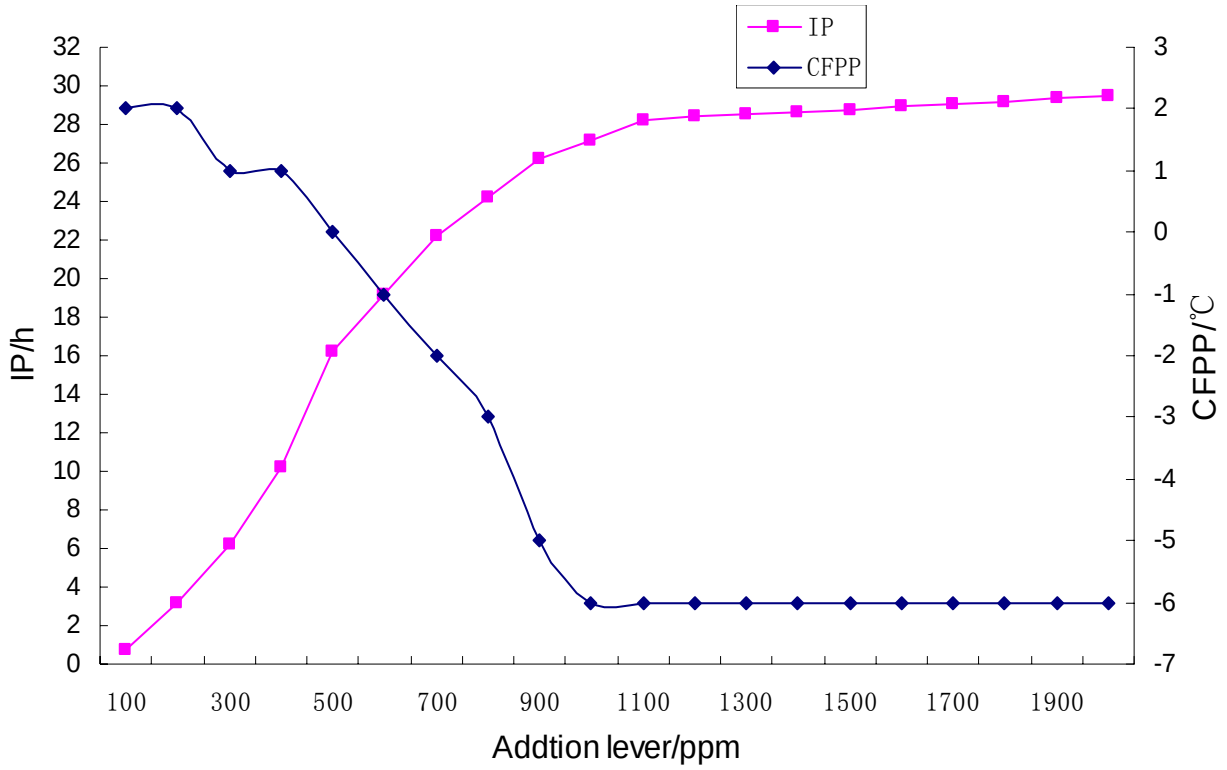

Fig 3. Effects of BI-W100 on IP and CFPP of WFME

Conclusions

- The compound improvers containing the antioxidants and the cold flow improvers could decrease the CFPP and also increase the IP of biodiesel.
- BI-P100 reduced the CFPP of the palm methyl ester by 8℃
- BI-W100 reduced the CFPP of the waster frying methyl ester by 8℃ and enhanced the IP by 29h