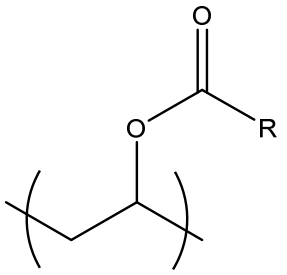
A number of solutions to this problem have been proposed and various additives which can be used to ameliorate the negative interaction have been described, for example, see EP1932899, US8021444, US8153567, US8628590, US8628591, US8734542, US20100154294, US20100180492 and US20100236139.

However due to the significant variability of fuels, the solutions that have been proposed do not always solve the problem and thus there is a continuing need for alternative solutions to this problem.

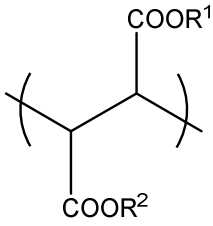
Summary of Disclosure

In one aspect, there is provided a method of improving the low temperature properties of a middle distillate fuel composition comprising (a) a nitrogen-containing dispersant; and (b) one or more low temperature property enhancers which are not fumarate vinyl ester copolymers and which are selected from (x) wax antisettling additives; (y) middle distillate flow improvers and mixtures thereof; the method comprising adding to the fuel an additive (c) which is a copolymer comprising units of formula (A):



(A)

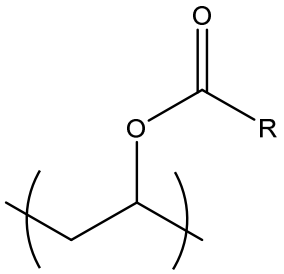
and units of formula (B):



(B)

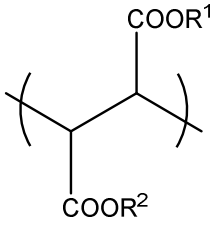
wherein R is an alkyl group and each of R^1 and R^2 is an alkyl group.

In another aspect, there is provided the use of (c) a copolymer comprising units of formula (A):



(A)

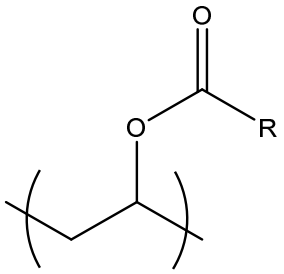
and units of formula (B):



(B)

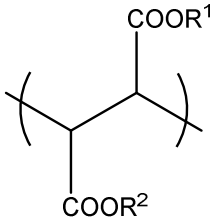
wherein R is an alkyl group and each of R^1 and R^2 is an alkyl group; to improve the low temperature properties of a middle distillate fuel composition comprising (a) a nitrogen-containing dispersant; and (b) one or more low temperature property enhancers which are not fumarate vinyl ester copolymers and which are selected from (x) wax antisettling additives; (y) middle distillate flow improvers and mixtures thereof.

In yet another aspect of the present disclosure, there is provided an additive composition for improving the low temperature properties of a middle distillate fuel composition, the additive composition comprising (b) one or more low temperature property enhancers which are not fumarate vinyl ester copolymers and which are selected from (x) wax antisettling additives; (y) middle distillate flow improvers and mixtures thereof; and (c) a copolymer comprising units of formula (A):



(A)

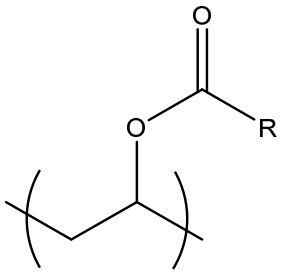
and units of formula (B):



(B)

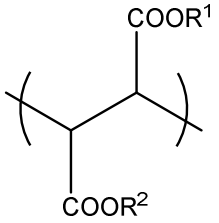
wherein R is an alkyl group and each of R^1 and R^2 is an alkyl group.

In a further aspect, there is provided a middle distillate fuel composition comprising (a) a nitrogen-containing dispersant; (b) one or more low temperature property enhancers which are not fumarate vinyl ester copolymers and which are selected from (x) wax antisettling additives; (y) middle distillate flow improvers and mixtures thereof; and (c) a copolymer comprising units of formula (A):



(A)

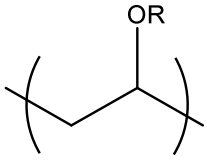
and units of formula (B):



(B)

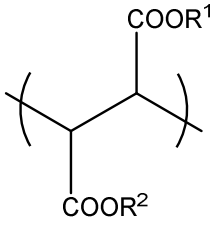
wherein R is an alkyl group and each of R^1 and R^2 is an alkyl group.

In another aspect, there is provided a use of an additive (c) which is a copolymer comprising units of formula (A):



(A)

and units of formula (B):



(B)

wherein R is an alkyl group and each of R^1 and R^2 is an alkyl group; to ameliorate an antagonistic interaction in a middle distillate fuel composition between (a) a nitrogen-containing dispersant; and (b) one or more low temperature property enhancers which are not fumarate vinyl ester copolymers and which are selected from (x) wax antisettling additives; (y) middle distillate flow improvers and mixtures thereof.

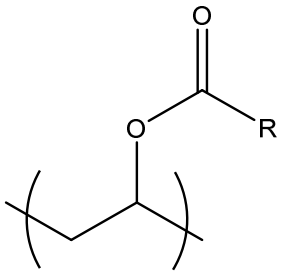
Detailed Description

According to a first aspect of the present invention there is provided a method of improving the low temperature properties of a middle distillate fuel composition comprising:

(a) a nitrogen-containing dispersant; and

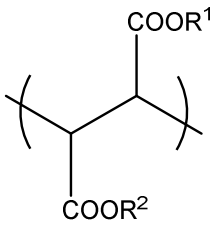
(b) one or more low temperature property enhancers which are not fumarate vinyl ester copolymers and which are selected from: (x) wax antisettling additives; (y) middle distillate flow improvers; and mixtures thereof;

the method comprising adding to the fuel an additive (c) which is a copolymer comprising units of formula (A):



(A)

and units of formula (B):



(B)

wherein R is an alkyl group and each of R^1 and R^2 is an alkyl group.