Claims

1. A process for the reactivation of an acidic ion exchange resin that has been at least partially deactivated by contact with an impure ethylenically unsaturated acid or ester containing organic target impurities comprising the step of:-
contacting the at least partially deactivated resin with a C_1-C_{12} aliphatic alkanol to thereby increase the activity thereof.

2. A process for the reactivation of an acidic ion exchange resin that has been at least partially deactivated by contact with an impure ethylenically unsaturated acid, ester or nitrile containing target impurities comprising the steps of:-
contacting the at least partially deactivated resin with a C_1-C_{12} aliphatic alkanol and a carboxylic acid to thereby increase the activity thereof.

3. A process for the reactivation of an acidic ion exchange resin according to claims 1 or 2, wherein the acidic ion exchange resin is in the form of a packed resin bed.

4. A process for the reactivation of an acidic ion exchange resin according to any of claims 1-3, wherein the resin bed is at least 10% reactivated by the process of the invention.

5. A process for the reactivation of an acidic ion exchange resin according to any preceding claim, wherein the volume of alkanol or alkanol and

carboxylic acid is such as will cause the deactivated bed to be sufficiently reactivated and to sufficiently remove the accumulated impurities.

6. A process for the reactivation of an acidic ion exchange resin according to claim 1, wherein at least one carboxylic acid is also present in the reactivation process.

7. A process for the reactivation of an acidic ion exchange resin according to any of claims 2-6, wherein the carboxylic acid is either added together with the alkanol or added separately.

8. A process for the reactivation of an acidic ion exchange resin according to any preceding claim, wherein the impure ethylenically unsaturated product of the present invention is produced by condensation of formaldehyde with methyl propionate to produce MMA.

9. A process for the reactivation of an acidic ion exchange resin according to any preceding claim, wherein the alkanol or alkanol and carboxylic acid is introduced to the resin in the form of a reactivation liquid.

10. A process for the reactivation of an acidic ion exchange resin according to claim 9, wherein the molar concentration of the alkanol in the reactivation liquid is at least 10 mol %.

11. A process for the reactivation of an acidic ion exchange resin according to claim 9, wherein the molar concentration of the carboxylic acid in the reactivation liquid is at least 2.5 mol%.

12. A process for the reactivation of an acidic ion exchange resin according to any of claims 2-11, wherein the impure ethylenically unsaturated acid or ester is produced via the reaction of a suitable methylene source in the presence of a catalyst with a carboxylic ester and wherein the resin reactivating alkanol and carboxylic acid are selected so that they form the said carboxylic ester and can thus be recycled as a reactant in the production process.

13. A process for the reactivation of an acidic ion exchange resin according to any preceding claim, wherein the impure ethylenically unsaturated acid or ester is produced via the reaction of a suitable source of formaldehyde in the presence of a catalyst with a carboxylic ester.

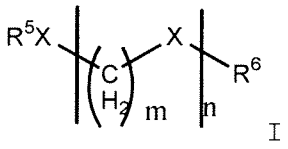
14. A process for preparing and purifying an ethylenically unsaturated acid or ester of the following formula:-

$R^1-C(=(CH_2)_m)-COOR^2$

wherein R^1 and R^2 are each, independently, hydrogen or an alkyl group with 1 to 12 carbon atoms; and m is 1 or 2;

the process comprising the steps of-

a) contacting an alkanoic acid or ester of the formula $R^1-CH_2-COOR^3$, wherein R^1 is as defined for the ethylenically unsaturated acid or ester above and R^3 is independently, hydrogen or an alkyl group with 1 to 12 carbon atoms, with a methylene or ethylene source of formula I, optionally in the presence of a suitable catalyst,



I

where R^5 and R^6 are independently selected from C_1-C_{12} hydrocarbons or H;

X is either O or S;

n is an integer from 1 to 100;

and m is 1 or 2;

and optionally in the presence of an alkanol to produce an impure ethylenically unsaturated acid or ester of the formula:-

$R^1-C(=(CH_2)_m)COOR^2$;

b) purifying the impure product of step a) by contact with an acidic ion exchange resin until the ion exchange resin is at least partially deactivated; and

c) treating the at least partially deactivated ion exchange resin with an alkanol of formula R^4OH, wherein R^4 is an alkyl group with 1 to 12 carbon atoms, and a carboxylic acid of formula:-

R^1-CH_2-COOH

to thereby reactivate the acidic ion exchange resin and produce as a by-product an ester of formula:-

$R^1-CH_2-COOR^4$;

d) optionally hydrolysing the ester of step c) to produce an acid of formula:-

R^1-CH_2-COOH;

e) recycling the said ester or acid of step c) or acid of step d) as a reactant in step a) with the proviso that when the ester of step c) is recycled, R^4 and R^3 are the same alkyl group.

15. Use of the process step c) of claim 14 to reactivate a deactivated resin bed.

16. A process for the reactivation of an acidic ion exchange resin according to any of claims 1-3, wherein the resins have been used to treat one or more target impurities in the impure ethylenically unsaturated liquid which treatment has led to deactivation of the resin.

17. A process for the reactivation of an acidic ion exchange resin according to claim 16, wherein suitable target impurities are selected from the list consisting of:- optionally substituted C_4-C_{20} dienes; optionally substituted C_6-C_{20} trienes; optionally substituted unsaturated aldehydes and ketones; divinyl ketone, ethyl vinyl ketone, ethyl isopropenyl ketone, 3-methylene 1-hexen-4-one, methacrolein and

isobutanol; pentenals; and a source of isobutyraldehyde.

18. A re-activated resin produced by a process according to any of claims 1-14 and 16-17.

~~19. A process as herein described with reference to the examples.~~

19. A process for the reactivation of an acidic ion exchange resin according to any of claims 1-14, 16 and 17, wherein the ion exchange resin is a sulphonic acid ion exchange resin.