CLAIMS ~~WHAT IS CLAIMED IS:~~

1. An activated and non-phthalate solid catalyst component for olefin polymerization comprising a reaction product of:

(a) a halide-containing magnesium compound;

(b) a titanium compound containing titanium in ~~an~~ oxidation states of at least +3 and +2;

(c) an organosilicon compound containing Si-O groups;

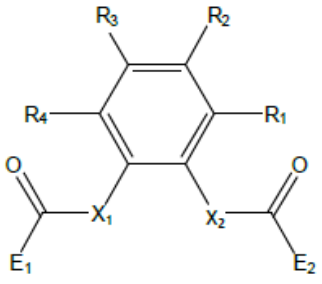
(d) an alkylaluminum compound;

(e) a supportive electron donor comprising a monobenzoate, the supportive electron donor being present in the catalyst component in an amount from ~~about~~ 0.01% to ~~about~~ 5% by weight;

(f) at least one internal electron donor, the at least one internal electron donor being present in the catalyst component in an amount from ~~about~~ 1% to ~~about~~ 15% by weight; and

a polymer formed from an alpha-olefin having the formula: $CH_2 = CHR_1$, wherein R_1 comprises hydrogen, or a C_1 to C_7 ~~C1 to C7~~ alkyl group, and being present in the catalyst component in an amount from ~~about~~ 0.3 g to ~~about~~ 200 g of polymer per gram of catalyst component; and

wherein the internal electron donor is represented by one of the following formulas:



wherein

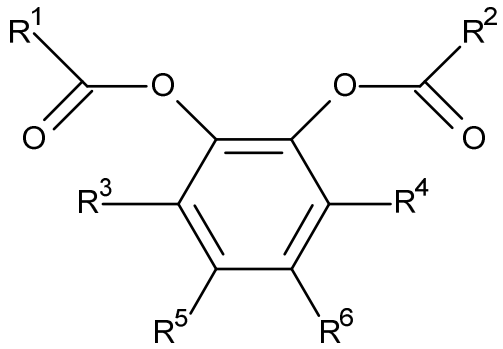
R_1-R_4 are the same or different and each R_1-R_4 is selected from the group consisting of hydrogen, a substituted hydrocarboyl group having 1

to 20 carbon atoms , an a unsubstituted hydrocarobyl having 1 to 20 carbon atoms, a substituted or unsubstitted aryl group having 6 to 20 carbons, an alkoxy group having 1 to 20 carbon atoms, a heteroatom and combinations thereof and at least one of R_1-R_4 is not hydrogen;

E_1 and E_2 are the same or different and each E_1 and E_2 is selected from the group consisting of a substituted hydrocarboyl group having 1 to 20 carbon atoms , an a unsubstituted hydrocarobyl having 1 to 20 carbon atoms, a substituted or unsubstitted aryl group having 6 to 20 carbons, an alkoxy group having 1 to 20 carbon atoms, a heteroatom and combinations thereof; and

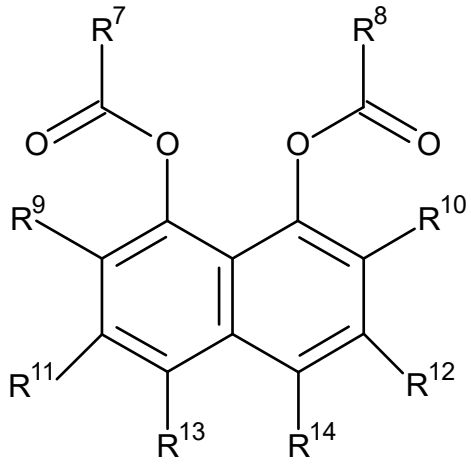
X_1 and X_2 are each O, S, an alkyl group, or NR_5 and wherein R_5 is a hydrocarbyl group having 1 to 20 carbon atoms or is hydrogen;

or



wherein each of R^1 through R^6 are independently H, F, Cl, Br, I, alkyl, cycloalkyl, cycloalkylalkyl, aryl, aralkyl, heterocyclyl, heterocyclylalkyl, heteroaryl, or heteroarylalkyl;

or



wherein each of R^7 through R^{14} are independently H, F, Cl, Br, I, alkyl, cycloalkyl, cycloalkylalkyl, aryl, aralkyl, heterocyclyl, heterocyclylalkyl, heteroaryl, or heteroarylalkyl groups.

~~2. An activated solid catalyst component as defined in claim 1, wherein the at least one internal electron donor comprises an aryl diester.~~

~~3~~2. An activated solid catalyst component as defined in claim 1~~ or 2~~, wherein the alpha-olefin comprises ethylene or propylene.

~~4~~3. An activated solid catalyst component as defined in claim 1~~, 2~~ or ~~3~~2, wherein the halide-containing magnesium compound ~~comprising~~ comprises magnesium chloride.

~~5~~4. An activated solid catalyst component as defined in claim 1~~, 2~~, ~~3~~ 2 or 43, wherein the olefin polymer is present in an amount less than or equal to ~~about~~ 20 g of polymer per gram of activated solid catalyst component.

~~6~~5. An activated solid catalyst component as defined in any of the preceding claims, wherein the organosilicon compound is a silane, siloxane or polysiloxane having the following chemical structure:

$$R_nSi(OR')_{4-n}$$

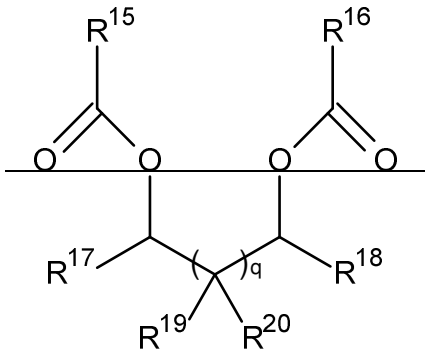
wherein:

each R is H, alkyl, or aryl;

each R' is H, alkyl, aryl, or a $SiR_{n'}(OR')_{3-n}$; and

n is 0, 1, 2, or 3.

~~7. An activated solid catalyst component as defined in any of the preceding claims, wherein the internal electron donor is represented by the following formula:~~

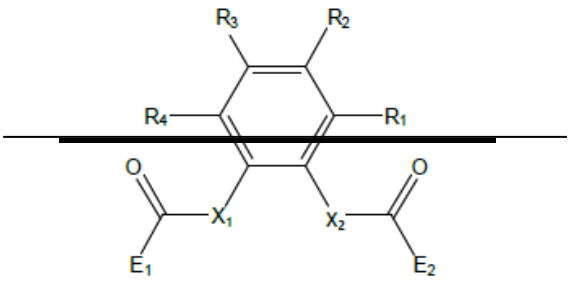


~~wherein:~~

~~each of R^{15} through R^{20} are independently H, F, Cl, Br, I, alkyl, cycloalkyl, cycloalkylalkyl, aryl, aralkyl, heterocyclyl, heterocyclylalkyl, heteroaryl, or heteroarylalkyl; and~~

~~q is an integer from 0 to 12.~~

~~8. An activated solid catalyst component as defined in any of the preceding claims, wherein the internal electron donor is represented by one of the following formulas:~~

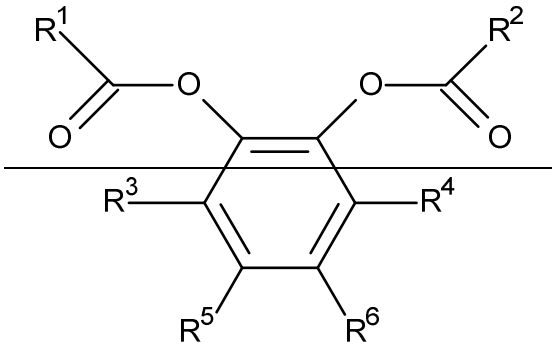


~~where R1-R4, are the same or different and each R1-R4is selected from the group consisting of hydrogen, a substituted hydrocarboyl group having 1 to 20 carbon atoms , an a unsubstituted hydrocarobyl having 1 to 20 carbon atoms, a substituted or unsubstitted aryl group~~

having 6 to 20 carbons, an alkoxy group having 1 to 20 carbon atoms, a heteroatom and combinations thereof and at least one of R1-R4is not hydrogen; and

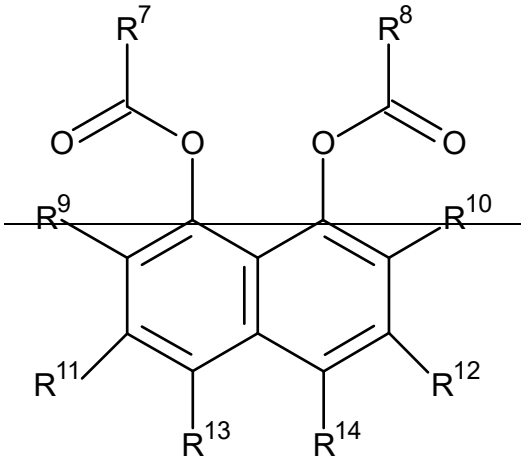
E1 and E2 are the same or different and each E1 and E2 is selected from the group consisting of a substituted hydrocarboyl group having 1 to 20 carbon atoms , an a unsubstituted hydrocarobyl having 1 to 20 carbon atoms, a substituted or unsubstitted aryl group having 6 to 20 carbons, an alkoxy group having 1 to 20 carbon atoms, a heteroatom and combinations thereof

wherein X_1 and X_2 are each O, S, an alkyl group, or NR_5 and wherein R_5 is a hydrocarbyl group having 1 to 20 carbon atoms or is hydrogen; or



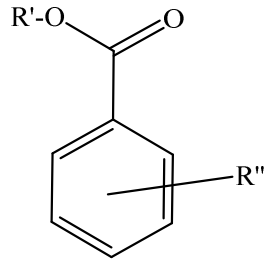
wherein:

each of R^1 through R^6 are independently H, F, Cl, Br, I, alkyl, cycloalkyl, cycloalkylalkyl, aryl, aralkyl, heterocyclyl, heterocyclylalkyl, heteroaryl, or heteroarylalkyl; or



~~wherein each of R^7 through R^{14} are independently H, F, Cl, Br, I, alkyl, cycloalkyl, cycloalkylalkyl, aryl, aralkyl, heterocyclyl, heterocyclylalkyl, heteroaryl, or heteroarylalkyl groups.~~

~~9~~6. An activated solid catalyst component as defined in any of the preceding claims, wherein the supportive electron donor has the following formula:



wherein R'comprises an alkyl group, a cyclic group, an aryl group having from 1 to 20 carbon atoms, a heteroatom or a combination thereof, and wherein R'' comprises one or more substituted groups, each substituted group can comprise independently hydrogen, an alkyl group, a cyclic group, an aryl group having from 1 to 20 carbon atoms, a heteroatom, or a combination thereof.

~~10~~7. An activated solid catalyst component as defined in any of the preceding claims, wherein the titanium compound comprises titanium having oxidation states of from +2 to +4, the +3 oxidation state titanium being present in an amount greater than 60%, such as greater than 65%, such as greater than 70%, the +4 oxidation state titanium being present in an amount of from 0.01% to 20%, and the +2 oxidation state titanium being present in an amount of from 1% to 20%.

~~11~~8. An activated solid catalyst component as defined in any of the preceding claims, wherein the catalyst component has an average particle size of from ~~about~~ 5 microns to ~~about~~ 300 microns, such as from ~~about~~ 5 microns to ~~about~~ 70 microns.

~~12~~9. An activated solid catalyst component as defined in any of the preceding claims, wherein the solid catalyst component further comprises an organic phosphorus compound.

~~13~~10. An activated solid catalyst component as defined in claim ~~12~~9, wherein the organic phosphorous compound comprises a phosphate acid ester.

~~14~~11. An activated solid catalyst component as defined in any of the preceding claims, wherein the activated solid catalyst component comprises catalyst particles and wherein the polymer formed from the alpha-olefin forms at least a partial coating on the catalyst particles.

~~15~~12. An activated solid catalyst component as defined in any of the preceding claims, further comprising an activity limiting agent.

~~16~~13. An activated solid catalyst component as defined in claim ~~15~~12, wherein the activity limiting agent comprises a C_4 to C_{30} ~~C4 to C30~~ aliphatic acid ester, a diether, or a poly(alkene glycol) ester of a C_4 to C_{30} ~~C4 to C30~~ aliphatic acid.

~~17~~14. An activated solid catalyst component as defined in any of the preceding claims, wherein the supportive electron donor is present in the catalyst component in an amount from ~~about~~ 0.01% to by weight to ~~about~~ 3% by weight and the at least one internal electron donor is present in the catalyst component in an amount from ~~about~~ 3% by weight to ~~about~~ 10% by weight.

~~18~~15. An activated solid catalyst component as defined in any of the preceding claims, wherein the solid catalyst component is activated in that the solid catalyst component contains titanium and carbon bonds.

~~19~~16. An activated solid catalyst component as defined in claim ~~9~~6, wherein the supportive electron donor comprises ethylbenzoate.

~~20~~17. An activated solid catalyst component as defined in any of the preceding claims, wherein the activated solid catalyst component contains aluminum to titanium in a molar ratio of from ~~about~~ 0.1 to ~~about~~ 200, such as from ~~about~~ 0.1 to ~~about~~ 20 and contains silicone to titanium in a molar ratio of from ~~about~~ 0.05 to ~~about~~ 10, such as from ~~about~~ 0.1 to ~~about~~ 10.

~~21~~18. An activated solid catalyst component as defined in any of the preceding claims, wherein a solid catalyst component is formed and then fed to a polymerization reactor for forming the activated solid catalyst having the polymer associated therewith.

~~22~~19. A process for producing an activated solid catalyst component, the process comprising:

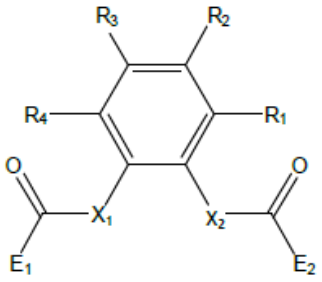
a. forming a catalyst precursor component by reacting a magnesium alkoxide $Mg(OR)_nX_{2-n}$ or magnesium alcholate $MgX_2mR'OH$ with Ti(OR'')gX4-g wherein X is Br, Cl, or I; and n is 1, 2;m is 0.5-10; g is 0, 1, 2, 3, or 4; and R, R', R'' are independently C_1-C_{10} ~~C1-C10~~ alkyl, the catalyst precursor containing a supportive electron donor and an internal electron donor;

b. reacting the product obtained from (a) with a trialkyl aluminum compound in the presence of an organosilicon compound having the following formula $R_2nSi(OR_3)4-n$, wherein R_2 is H, alkyl, or aryl; each R_3 is alkyl, or aryl; n is 0, 1, 2 or 3~~-~~ ;

c. reacting the product obtained in (b) with an olefin having the formula CH_2=CHR' ~~CH2=CHR'~~ wherein R' =H, or a C_1-C_7 ~~C1-C7~~ alkyl group and polymerizing the olefin to form a polymer coating on the solid catalyst component particles, the olefin polymer being present in an amount of less than 200 g per 1 g of the activated solid catalyst component~~-~~ ; and

d. isolating the activated solid catalyst component; and

wherein the internal electron donor is represented by one of the following formulas:



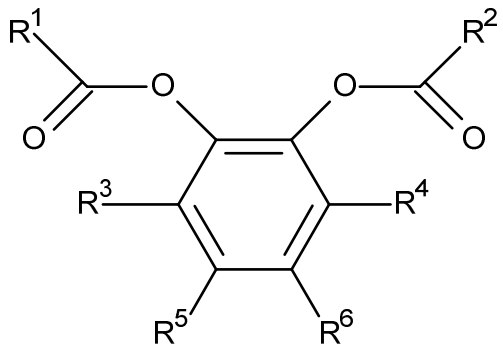
wherein

R_1-R_4 are the same or different and each R_1-R_4 is selected from the group consisting of hydrogen, a substituted hydrocarboyl group having 1 to 20 carbon atoms , an a unsubstituted hydrocarobyl having 1 to 20 carbon atoms, a substituted or unsubstitted aryl group having 6 to 20 carbons, an alkoxy group having 1 to 20 carbon atoms, a heteroatom and combinations thereof and at least one of R_1-R_4 is not hydrogen;

E_1 and E_2 are the same or different and each E_1 and E_2 is selected from the group consisting of a substituted hydrocarboyl group having 1 to 20 carbon atoms , an a unsubstituted hydrocarobyl having 1 to 20 carbon atoms, a substituted or unsubstitted aryl group having 6 to 20 carbons, an alkoxy group having 1 to 20 carbon atoms, a heteroatom and combinations thereof; and

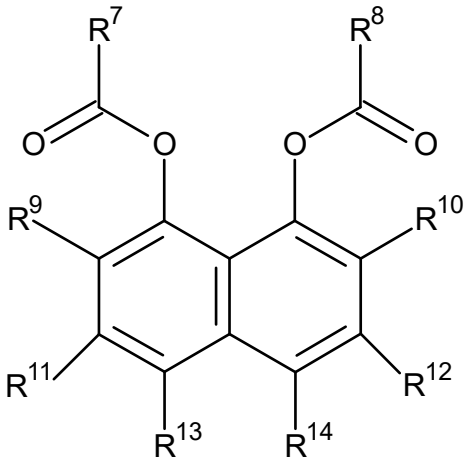
X_1 and X_2 are each O, S, an alkyl group, or NR_5 and wherein R_5 is a hydrocarbyl group having 1 to 20 carbon atoms or is hydrogen;

or



wherein each of R^1 through R^6 are independently H, F, Cl, Br, I, alkyl, cycloalkyl, cycloalkylalkyl, aryl, aralkyl, heterocyclyl, heterocyclylalkyl, heteroaryl, or heteroarylalkyl;

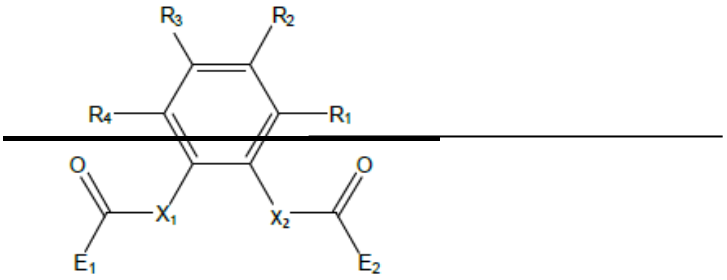
or



wherein each of R^7 through R^{14} are independently H, F, Cl, Br, I, alkyl, cycloalkyl, cycloalkylalkyl, aryl, aralkyl, heterocyclyl, heterocyclylalkyl, heteroaryl, or heteroarylalkyl groups.

~~23~~20. A process as in claim ~~22~~19, wherein the activity limiting agent is added in step b) and the activity limited agent comprises a C_4 to C_{30} ~~C4 to C30~~ aliphatic acid ester, a diether, or a poly(alkene glycol) ester of a C_4 to C_{30}~~C4 to C30~~ aliphatic acid is added.

~~24~~21. A process as in claim ~~22~~ 19 or ~~23~~20, wherein ~~the internal electron donor is represented by one of the following formulas:~~

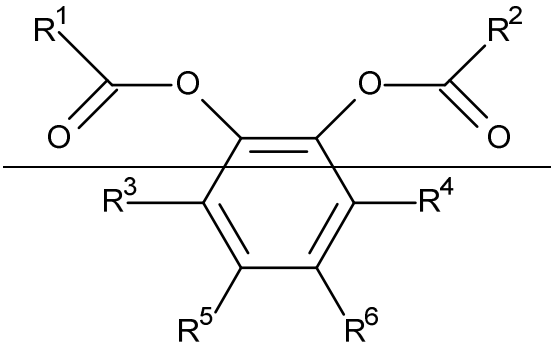


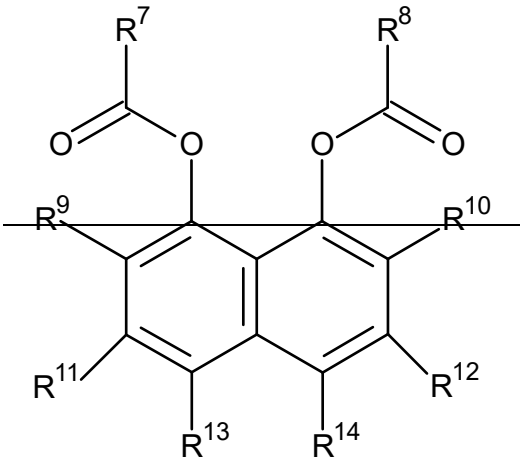
~~where R1-R4, E1, E2 are the same or different and each R1-R4E1,E2 is selected from the group consisting of hydrogen, a substituted hydrocarboyl group having 1 to 20 carbon atoms, an a unsubstituted hydrocarobyl having 1 to 20 carbon atoms, a substituted or unsubstitted aryl group having 6 to 20 carbons, an alkoxy group having 1 to 20 carbon atoms, a heteroatom and combinations thereof and at least one of R1-R4 is not hydrogen;~~

~~E1 and E2 are the same or different and each E1 and E2 is selected from the group consisting of a substituted hydrocarboyl group having 1 to 20 carbon atoms , an a unsubstituted hydrocarobyl having 1 to 20 carbon atoms, a substituted or unsubstitted aryl group having 6 to 20 carbons, an alkoxy group having 1 to 20 carbon atoms, a heteroatom and combinations thereof;~~

~~and wherein X_1 and X_2 are each O, S, an alkyl group, or NR_5 and wherein R_5 is a hydrocarbyl group having 1 to 20 carbon atoms or is hydrogen;~~

~~or~~



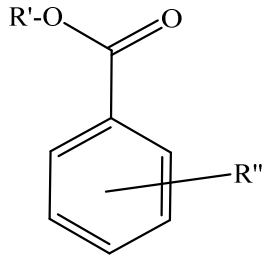


~~wherein:~~

~~each of R^1 through R^{14} are independently H, F, Cl, Br, I, alkyl, cycloalkyl, cycloalkylalkyl, aryl, aralkyl, heterocyclyl, heterocyclylalkyl, heteroaryl, or heteroarylalkyl; and~~

~~q is an integer from 0 to 12.~~

~~and wherein~~ the supportive electron donor has the following formula:



wherein R' comprises an alkyl group, a cyclic group, an aryl group having from 1 to 20 carbon atoms, a heteroatom or a combination thereof, and wherein R'' comprises one or more substituted groups, each substituted group can comprise independently hydrogen, an alkyl group, a cyclic group, an aryl group having from 1 to 20 carbon atoms, a heteroatom, or a combination thereof.

~~25~~22. A process for producing olefin polymers comprising:

polymerizing an olefin in the presence of an activated solid catalyst component as defined in any one of claims 1-21 in a gas phase polymerization reactor, ~~the activated solid catalyst component comprising:~~

~~(a) a halide-containing magnesium compound;~~

~~(b) a titanium compound wherein titanium has as oxidation state oxidation states of at least +3 and +2;~~

~~(c) an organosilicon compound containing Si-O groups;~~

~~(d) an alkyl-aluminum compound;~~

~~(e) a supportive electron donor comprising a mono benzoate, the supportive electron donor being present in the catalyst component in an amount from about 0.01% to about 5% by weight;~~

~~(f) at least one internal electron donor, the internal electron donor comprising an aryl diester, the at least one internal electron donor being present in the catalyst component in an amount from about 1% to about 15% by weight; and~~

~~(g) a polymer formed from an alpha-olefin having the formula: $CH_2=CHR_1$, wherein R_1 comprises hydrogen, or a C_1 to C_7 C1 to C7 alkyl group, the alpha-olefin polymer forming a coating on the catalyst particles and being present in the~~

~~catalyst component in an amount from about 0.3 g to about 200 g of polymer per gram of catalyst particles;~~

wherein the activated solid catalyst component is prepared outside of the polymerization reactor and fed to the reactor.

~~26~~23. A process as defined in claim ~~25~~22, wherein the olefin is polymerized in a fluidized bed.

~~27~~24. A process as defined in claim ~~25~~22, wherein the olefin is polymerized in a stirred gas reactor.

~~28~~25. A process as defined in claim ~~25~~22, ~~26~~23, or ~~27~~ 24 wherein the solid catalyst component is fed to the reactor in combination with the olefin for producing an olefin polymer.

~~29~~26. A process as defined in any of claims ~~25~~22-~~28~~25, wherein the process produces a polypropylene homopolymer or a polypropylene copolymer.

~~30~~27. A process as defined in claim ~~29~~26, wherein the polymer produced by the process has a B/L3 of greater than ~~about~~ 0.75 and has a bulk density of greater than ~~about~~ 0.4 g/cc, such as from ~~about~~ 0.45 g/cc to ~~about~~ 0.6 g/cc.

~~31~~28. A process as defined in claim ~~29~~ 26 or ~~30~~27, wherein the polymer produced by the process has a flowability of greater than ~~about~~ 3.5 g/sec, such as greater than ~~about~~ 4 g/sec measured by a funnel with outlet diameter of 8.0 mm.

~~32~~29. A process as defined in claim ~~29~~26, ~~30~~ 27 or ~~31~~28, wherein the polymer produced by the process is a propylene-ethylene impact copolymer, containing ethylene in a rubber part in an amount of greater than ~~about~~ 30% by weight, such as from ~~about~~ 40% to 65% by weight of the rubber part.