~~U.S.~~ CLAIMS

1. A process for producing polymers of different molecular weights, the process comprising:

(A) for a first time period conducting a first polymerization to produce a first polymer by a process comprising:

(i) effecting continuous polymerization of a first monomer in a first solvent to produce a first product effluent comprising the first solvent, the first polymer, and unreacted first monomer;

(ii) heating the first product effluent;

(iii) feeding the first product effluent under pressure to a first valve upstream of a separator;

(iv) reducing the pressure of the first product effluent downstream of said first valve by an amount sufficient to separate the first product effluent into two phases in the separator said phases comprising a first polymer-rich phase and a first polymer-lean phase comprising said first solvent and unreacted first monomer wherein the polymer-rich phase is substantially in the liquid phase or supercritical phase and the polymer-lean phase is substantially in the liquid phase or supercritical phase;

(v) recovering the first polymer from said first polymer-rich phase; and

(vi) recycling unreacted first monomer and first solvent from the first polymer-lean phase to said polymerization A(i); and

(B) for a second time period conducting a second polymerization to produce a second polymer having a lower molecular weight than the first polymer by a process comprising:

(i) effecting continuous polymerization of a second monomer in a second solvent to produce a second product effluent comprising the second solvent, the second polymer, and unreacted second monomer;

(ii) heating the second product effluent;

(iii) feeding the second product effluent under pressure to said separator;

(iv) reducing the pressure of the second product effluent in said separator by an amount sufficient to separate the second product effluent into a second

polymer-rich liquid phase and a second polymer-lean vapor phase comprising said second solvent and unreacted second monomer;

(v) recovering the second polymer from said second polymer-rich liquid phase;

(vi) cooling the second polymer-lean vapor phase to condense said second solvent and said unreacted second monomer therefrom; and

(vii) recycling the condensed second solvent and unreacted second monomer to said polymerization B(i)~~;~~

wherein the second polymer is a low molecular weight polymer wherein the low molecular weight polymer is a polymer having more than 10 wt.% of its molecular weight distribution below 10,000 g/mol.

2. The process of claim 1, wherein the heating step of the first product effluent in A(ii) is provided by at least two heating stages wherein the first heating stage comprises heat transfer from the first polymer-lean phase in at least one primary heat exchanger and the second heating stage comprises heat transfer from an external source of heat in at least one secondary heat exchanger before being fed to the separator in (A)(iii).

3. The process of claim 1, wherein the heating step of the second product effluent in B(ii) is provided by at least two heating stages wherein the first heating stage comprises heat transfer from the second polymer-lean vapor phase in at least one primary heat exchanger and the second heating stage comprises heat transfer from an external source of heat in at least one secondary heat exchanger before being fed to the separator in (B)(iii).

4. The process of claim 1, wherein the first polymer is a high molecular weight polymer wherein the high molecular weight polymer is a polymer having less than 20 wt.% of its molecular weight distribution below 10,000 g/mol.

~~5. The process of claim 1, wherein the second polymer is a low molecular weight polymer wherein the low molecular weight polymer is a polymer having more than 10~~

~~wt.% of its molecular weight distribution below 10,000 g/mol.~~

~~6.~~5. The process of claim 1, wherein the first polymer has a molecular weight greater than 125,000 g/mol and the second polymer has a molecular weight less than 90,000 g/mol.

~~7.~~6. An apparatus for recovering ~~polymers~~ a first and a second polymer of different molecular ~~weight~~ weights produced sequentially by continuous solution polymerization in one or more polymerization reactors, the apparatus comprising:

a supply line for receiving a pressurized effluent of polymer, solvent, and unreacted monomer from the polymerization reactor(s);

one or more heat exchangers connected to the supply line for heating the pressurized effluent;

a separator for receiving the heated and pressurized effluent from the heat exchanger(s), the separator having a first outlet for a polymer-rich stream and a second outlet for a polymer-lean stream;

a pressure regulator operable to lower the pressure in the separator to at least (i) a first level at which the effluent in said separator separates into two liquid/SCF phases comprising a polymer-rich phase and polymer-lean phase, and (ii) a second level lower than the first level at which the effluent in said separator separates into a polymer-rich liquid phase and polymer-lean vapor phase;

first valve means operable when the pressure in the separator is at said first level to supply a polymer-lean phase from the separator through the one or more heat exchangers to the polymerization reactor(s);

a condenser;

second valve means operable when the pressure in the separator is at said second level to supply a polymer-lean vapor phase from the separator through the one or more heat exchangers to the condenser; and

third valve means operable to supply condensed polymer-lean vapor phase from the condenser to the polymerization reactor.

~~8.~~7. The apparatus of claim ~~7~~ 6, wherein the first polymer is a high molecular

weight polymer wherein the high molecular weight polymer is a polymer having less than 20 wt.% of its molecular weight distribution below 10,000 g/mol.

~~9.~~8. The apparatus of claim ~~7~~ 6, wherein the second polymer is a low molecular weight polymer wherein the low molecular weight polymer is a polymer having more than 10 wt.% of its molecular weight distribution below 10,000 g/mol.

~~10.~~9. The apparatus of claim ~~7~~ 6, wherein the first polymer has a molecular weight greater than 125,000 g/mol and the second polymer has a molecular weight less than 90,000 g/mol.