APPENDIX A

Co Catalyst Formulations

Catalyst Prep #:	Co.057	Date Tech	Oct- 10-1994	Amount	200.0 g

Compound	Co	Re	La2O3	SiO2
(%wt)	20	1	1	

Support	Silica Davison Grade 952	Amount	156.00 g
Particle Size	400 - 0 mesh	Treatment	500°C / 10 hr
Cobalt	Cobalt Nitrate	Amount	197.29 g
Metal	Perrhenic Acid	Amount	3.67 g
Promotor Promotor Promotor	La-Nitrate	Amount Amount Amount	5.31 g

PROCEDURE

Preparation: X Incipient Wetness; Wet Impregnation; Ion Exchange; Other

Notes: Incipient wetness: aqueous solution - ca. 1.2 ml/g support
Dry catalyst precursor in an oven at 115°C / 5 hr

Calcination: Temperature 300°C Time 2 hr

Notes: 50g of the catalyst precursor is not to be calcined !!

Co.057: **20 wt% Co**
1 wt% Re
1 wt% La_2O_3
Silica

La/Re-promoted SiO_2-supported catalyst comparable to Co.055 where SiO_2 is used as support instead of Al_2O_3

Preparation Procedure:

Calcine the SiO_2 at 500°C for 10 hrs. Presieve to >38 microns (400-0 mesh).

Impregnate the support with an aqueous solution of Co nitrate [$Co(NO_3)_2 \cdot 6H_2O$], perrhenic acid [$HReO_4$], lanthanum nitrate, and using an appropriate quantity to get incipient wetness (ca. 1.2 ml/g) with the desired loading of Co.

Dry the catalyst precursor in an oven for 5 hrs at 115°C with moderate stirring.

The dried catalyst is then calcined in air by raising its temperature at a heating rate of ca. 1°C/min to 300°C and holding for 2 hrs.

Reduction Procedure before Reaction:

Reduce the catalyst in a pure hydrogen flow of 3000 cc/g/hr by heating at 1°C/min to 250°C and holding for 10 hrs.

Catalyst Prep #	Co.058	Date Tech	Oct. 10-1994	Amount	200.0 g

Compound	Co	La2O3	Al2O3
(%wt)	20	1	

Support	y-Alumina / Vista-B	Amount	158.00 g
Particle Size	400 - 0 mesh	Treatment	500°C / 10 hr
Cobalt	Cobalt Nitrate	Amount	197.29 g
Metal		Amount	
Promotor		Amount	
Promotor	La-Nitrate	Amount	5.31 g
Promotor		Amount	

PROCEDURE

Preparation — X — Incipient Wetness — Wet Impregnation
Ion Exchange — Other

Notes: Incipient wetness: aqueous solution - ca. 1.2 ml/g support
Dry catalyst precursor in an oven at 115°C / 5 hr

Calcination — Temperature: 300°C — Time: 2 hr

Notes: 50g of the catalyst precursor is not to be calcined !!

Co.058: **20 wt% Co**
1 wt% La_2O_3
γ-alumina

La-promoted Al_2O_3-supported catalyst comparable to Co.055 without Re.

Preparation Procedure:

Calcine the γ-alumina at 500°C for 10 hrs. Use Vista B alumina. Presieve to 38-63 microns (400-250 mesh).

Impregnate the support with an aqueous solution of Co nitrate [$Co(NO_3)_2 \cdot 6H_2O$], lanthanum nitrate, and using an appropriate quantity to get incipient wetness (ca. 1.2 ml/g) with the desired loading of Co.

Dry the catalyst precursor in an oven for 5 hrs at 115°C with moderate stirring.

The dried catalyst is then calcined in air by raising its temperature at a heating rate of ca. 1°C/min to 300°C and holding for 2 hrs.

Reduction Procedure before Reaction:

Reduce the catalyst in a pure hydrogen flow of 3000 cc/g/hr by heating at 1°C/min to 350°C and holding for 10 hrs.

Catalyst Prep #	Co.059	Date Tech	Oct-10-94	Amount	200 g

Compound	Co	La2O3	Al2O3
(%wt)	20	1	

Support	y-Alumina VISTA B	Amount	
Particle Size	400 - 0 mesh	Treatment	600°C / 2 hrs
Cobalt	Cobalt Nitrate	Amount	
Metal		Amount	
Promotor	Lanthanum Nitrate	Amount	
Promotor		Amount	
Promotor		Amount	

PROCEDURE

Preparation — X Incipient Wetness; Wet Impregnation; Ion Exchange; Other

Notes: Incipient wetness: aqueous solution of cobalt nitrate - ca. 1 ml/g
Dry catalyst precursor at 120°C / 16 hrs
Incipient wetness: aqueous solution of La

Calcination — Temperature: 300 deg C Time: 2 hr

Notes: 50 g of precursor is not to be calcined

Co.059: **20 wt% Co**
1 wt% La_2O_3
γ-alumina

Similar to Co.015, but without Ru.

Preparation Procedure:

Calcine the γ-alumina at 600°C for 2 hrs. Use Vista B alumina. Presieve to >38 microns (400-0 mesh).

Impregnate the support with an aqueous solution of Co nitrate [$Co(NO_3)_2 \cdot 6H_2O$] using an appropriate quantity to get incipient wetness (ca. 1 ml/g) with the desired loading of Co.

Dry the catalyst precursor for 16 hrs at 120°C.

Impregnate the catalyst precursor with an aqueous solution of lanthanum nitrate hexahydrate using an appropriate quantity to get incipient wetness with the desired loading of La_2O_3.

Dry the catalyst precursor at 90°C with moderate stirring.

Reduction Procedure before Reaction:

Reduce the catalyst in a pure hydrogen flow of 1000 cc/g/hr by heating to 350°C and holding overnight (for 16 hrs).

Catalyst Prep #	Co.060	Date Tech	Oct. -10-94	Amount	250.0 g
Compound (%wt)		Co 30			Al2O3

Support	y-Alumina / Vista-B	Amount	175.00 g
Particle Size	400 - 0 mesh	Treatment	500°C / 10 hr
Cobalt	Cobalt Nitrate	Amount	369.92 g
Metal		Amount	
Promotor Promotor Promotor		Amount Amount Amount	

PROCEDURE

Preparation — X — Incipient Wetness — Wet Impregnation
Ion Exchange — Other

Notes: Incipient wetness: aqueous solution - ca. 1.2 ml/g - 60% of loading in first step
Dry catalyst precursor in an oven at 115°C / 12 hrs - calcine 300°C / 2 hrs
Incipient wetness: aqueous solution - ca. 1.2 ml/g - remaining 40% of loading
Repeat drying and calcination

Calcination — Temperature _____ Time _____

Notes:

Co.060:

30 wt% Co
γ-alumina

Non-promoted catalyst similar to Co.005, with 30% Co.

Preparation Procedure:

Calcine the γ-alumina at 500°C for 10 hrs. Use Vista B alumina. Presieve to >38 microns (400-0 mesh).

Impregnate the support in 2 steps with an aqueous solution of Co nitrate [$Co(NO_3)_2 \cdot 6H_2O$], using an appropriate quantity to get incipient wetness (ca. 1.2 ml/g) with 60% of the desired loading of Co in the first step.

Dry in air at 115°C for 12 hours and calcine in air at 300°C for 2 hours (heating rate of ca. 1°C/min to 300°C).

In the second step, impregnate the remaining 40% of the Co. Repeat the drying and calcination procedures.

Reduction Procedure before Reaction:

Reduce the catalyst in a pure hydrogen flow of 3000 cc/g/hr by heating at 1°C/min to 350°C and holding for 10 hrs.

Catalyst Prep #	Co.061	Date Tech	Oct-10-94	Amount	250.0 g

Compound	Co	Rn	Al2O3
(%wt)	30	0.5	

Support	y-Alumina VISTA B	Amount	173.75 g
Particle Size	400 - 0 mesh	Treatment	500°C / 10 hrs
Cobalt	Cobalt Nitrate	Amount	369.92 g
Metal	Ruthenium Nitrosylnitrate	Amount	4.46 g
Promotor		Amount	
Promotor		Amount	
Promotor		Amount	

PROCEDURE

Preparation — X Incipient Wetness; Wet Impregnation; Ion Exchange; Other

Notes: Incipient wetness: aqueous solution - ca. 1.2 ml/g - 60% of loading in first step
Dry catalyst precursor in an oven at 115°C / 12 hrs - calcine 300°C / 2 hrs
Incipient wetness: aqueous solution - ca. 1.2 ml/g - remaining 40% of loading
Repeat drying and calcination

Calcination — Temperature _____ Time _____

Notes:

Co.061:

30 wt% Co
0.5 wt% Ru
γ-alumina

Ru-promoted catalyst similar to Co.053 with 30% Co.

Preparation Procedure:

Calcine the γ-alumina at 500°C for 10 hrs. Use Vista B alumina. Presieve to >38 microns (400-0 mesh).

Impregnate the support in 2 steps with an aqueous solution of Co nitrate [$Co(NO_3)_2 \cdot 6H_2O$], and Ru nitrosyl nitrate using an appropriate quantity to get incipient wetness (ca. 1.2 ml/g) with 60% of the desired loading of Co and Ru in the first step.

Dry in air at 115°C for 12 hours and calcine in air at 300°C for 2 hours (heating rate of ca. 1°C/min to 300°C).

In the second step, impregnate the remaining 40% of the Co and Ru. Repeat the drying and calcination procedures.

Reduction Procedure before Reaction:

Reduce the catalyst in a pure hydrogen flow of 3000 cc/g/hr by heating at 1°C/min to 350°C and holding for 10 hrs.

Catalyst Prep #	Co.062	Date Tech	Oct-10-94	Amount	250.0 g

Compound	Co	Rn	K	Al2O3
(%wt)	30	0.5	1.5	

Support	y-Alumina VISTA B	Amount	170.00 g
Particle Size	400 - 0 mesh	Treatment	500°C / 10 hrs
Cobalt	Cobalt Nitrate	Amount	369.92 g
Metal	Ruthenium Nitrosylnitrate	Amount	4.66 g
Promotor	Potassium Nitrate	Amount	9.71 g
Promotor		Amount	
Promotor		Amount	

PROCEDURE

Preparation — X Incipient Wetness — Wet Impregnation — Ion Exchange — Other

Notes: Incipient wetness: aqueous solution - ca. 1.2 ml/g - 60% of loading in first step
Dry catalyst precursor in an oven at 115°C / 12 hrs - calcine 300°C / 2 hrs
Incipient wetness: aqueous solution - ca. 1.2 ml/g - remaining 40% of loading
Repeat drying and calcnation

Calcination — Temperature _____ Time _____

Notes

Co.062: **30 wt% Co**
0.5 wt% Ru
1.5 wt% K
γ-alumina

Ru/K-promoted catalyst similar to Co.029 with 1.5% K.

Preparation Procedure:

Calcine the γ-alumina at 500°C for 10 hrs. Use Vista B alumina. Presieve to >38 microns (400-0 mesh).

Impregnate the support in 2 steps with an aqueous solution of Co nitrate [$Co(NO_3)_2 \cdot 6H_2O$], Ru nitrosyl nitrate, and K nitrate using an appropriate quantity to get incipient wetness (ca. 1.2 ml/g) with 60% of the desired loading of Co, Ru, and K in the first step.

Dry in air at 115°C for 12 hours and calcine in air at 300°C for 2 hours (heating rate of ca. 1°C/min to 300°C).

In the second step, impregnate the remaining 40% of the Co, Ru, and K. Repeat the drying and calcination procedures.

Reduction Procedure before Reaction:

Reduce the catalyst in a pure hydrogen flow of 3000 cc/g/hr by heating at 1°C/min to 350°C and holding for 10 hrs.

Catalyst Prep #	Co.063	Date Tech	Nov-07-94	Amount	200.0 g

Compound	Co	La	Al2O3
(%wt)	20	8.5	

Support	y-Alumina VISTA B	Amount	143.00 g
Particle Size	400 - 0 mesh	Treatment	500°C / 10 hrs
Cobalt	Cobalt Nitrate	Amount	197.29 g
Metal		Amount	
Promotor	La-Nitrate	Amount	105.91 g
Promotor		Amount	
Promotor		Amount	

PROCEDURE

Preparation X Incipient Wetness Wet Impregnation
Ion Exchange Other

Notes Incipient wetness: aqueous solution of La
Dry catalyst precursor in an oven 115°C / 5 hrs with stirring/calcine at 300 °C/2hrs
Incipient wetness: aqueous solution of Co with catalyst precursor
Dry catalyst precursor in an oven 115°C / 5 hrs with stirring/calcine at 300 C/2 hrs

Calcination Temperature 300°C Time 2 hrs

Notes 50g of the catalyst precursor are not to be calcined !!

Co.063: **20 wt% Co**
8.5 wt% La
Al_2O_3

La-promoted Al_2O_3-supported catalyst comparable to Co.056 with SiO_2 replaced by Al_2O_3 as the support. One-step impregnation of alumina with lanthanum nitrate followed by one-step impregnation with cobalt nitrate solution.

Preparation Procedure:

Calcine the γ-alumina at 500°C for 10 hrs. Use Vista B alumina. Presieve to >38 microns (400-0 mesh).

Impregnate the support with an aqueous solution of La nitrate using an appropriate quantity to get incipient wetness with the desired loading of La.

Dry the La-loaded Al_2O_3 in an oven for 5 hrs at 115°C with moderate stirring.

Calcine the dried support in air by raising its temperature at a heating rate of ca. 1°C/min to 300°C and holding for 2 hrs.

Impregnate the La-loaded alumina with an aqueous solution of Co nitrate [$Co(NO_3)_2 \cdot 6H_2O$] using an appropriate quantity to get incipient wetness with the desired loading of Co.

Dry the catalyst precursor in an oven for 5 hrs at 115°C with moderate stirring.
Calcine the dried catalyst in air by raising its temperature at a heating rate of ca. 1°C/min to 300°C and holding for 2 hrs.

Reduction Procedure before Reaction:

Reduce the catalyst in a pure hydrogen flow of 3000 cc/g/hr by heating at 1°C/min to 350°C and holding for 10 hrs.

Catalyst Prep #	CoW.08	Date Tech	Oct-10-94	Amount	100.0 g

Compound	Co	Cu	Cr	Al2O3
(%wt)	30	5	4	

Support	y-Alumina VISTA B	Amount	61.00 g
Particle Size	400 - 0 mesh	Treatment	500°C / 10 hrs
Metal I	Cobalt Nitrate	Amount	147.97 g
Metal II	Copper (II) Nitrate	Amount	19.01 g
Metal III	Chromium (III) Nitrate	Amount	30.77 g
Promotor		Amount	
Promotor		Amount	

PROCEDURE

Preparation: X Incipient Wetness; Wet Impregnation; Ion Exchange; Other

Notes: Incipient wetness: aqueous solution Cu + Cr, ca. 1.2 ml/g
Dry catalyst precursor in an oven 110°C / 16 hrs/Calcine 750 °C 24 hrs.
Incipient wetness: aqueous solution Co.
Dry catalyst precursor in an oven 115°C / 5 hrs.

Calcination: Temperature 300°C Time 10 hrs

Notes:

CoW.08

30 wt% Co
5 wt% Cu
4 wt% Cr
γ-alumina

Cobalt impregnation on calcined Cu-Cr/γ-alumina. Similar to CoW.05, but with 30% Co.

Preparation Procedure

Calcine γ-alumina at 500°C for 10 hrs. Use Vista B alumina. Presieve to > 38 microns (400-0 mesh).

Impregnate the support with an aqueous solution of $Cu(NO_3)_2.xH_2O$, and $Cr(NO_3)_3.9H_2O$ using appropriate quantity to get incipient wetness (ca. 1.2 ml/g) with the desired loading of Cu and Cr.

Dry the catalyst precursor in an oven for 16 hours at 110°C.

The dried catalyst is then calcined in air by raising its temperature at a heating rate of ca. 1°C/min to 750°C and holding for 24 hours.

Impregnate the $Cu\text{-}Cr/Al_2O_3$ with an aqueous solution of Co nitrate $[Co(NO_3)_2{\cdot}6H_2O]$ using an appropriate quantity to get incipient wetness with the desired loading of Co.

Dry the catalyst precursor in an oven for 5 hrs at 115°C with moderate stirring.

Calcine the dried catalyst in air by raising its temperature at a heating rate of ca. 1°C/min to 300°C and holding for 10 hrs.

Reduction Procedure before Reaction:

Heat the catalyst in inert gas to 120°C at a rate of 1°C/min then start adding hydrogen to give a concentration of 0.5% at the bed inlet. Raise the catalyst bed temperature to 165°C at a rate of ca. 30°C/hr. When the temperature of the bed has reached 160°C increase the hydrogen concentration in the carrier gas to 1.0%. As the reduction proceeds and the temperature rise begins to diminish, the inlet temperature may be raised to 200°C. The inlet hydrogen concentration can then be increased to about 3-5%, provided that the maximum temperature limit of 230°C is not exceeded. When the reduction appears to be complete the inlet temperature should be raised to 230°C and the inlet hydrogen concentration raised to ca. 20%.

Catalyst Prep #	CoW.09	Date Tech	Oct-10-94	Amount	100.0 g

Compound	Co	Cu	Cr	Al2O3
(%wt)	20	10	8	

Support	SiO2	Amount	62.00 g
Particle Size	400 - 0 mesh	Treatment	500°C / 10 hrs
Metal I	Cobalt Nitrate	Amount	98.64 g
Metal II	Copper (II) Nitrate	Amount	38.01 g
Metal III	Chromium (III) Nitrate	Amount	61.54 g
Promotor		Amount	
Promotor		Amount	

PROCEDURE

Preparation	X	Incipient Wetness	Wet Impregnation
		Ion Exchange	Other

Notes: Incipient wetness: aqueous solution Cu + Cr
Dry catalyst precursor in an oven 110°C / 16 hrs/Calcine 500 °C 24 hrs.
Incipient wetness: aqueous solution Co.
Dry catalyst precursor in an oven 115°C / 5 hrs.

Calcination: Temperature 300°C Time 10 hrs

Notes:

CoW.09

20 wt% Co
10 wt% Cu
8 wt% Cr
Silica

Cobalt impregnation on calcined Cu-Cr/Silica. Similar to CoW.06, but with 10% Cu and 8% Cr.

Preparation Procedure

Calcine silica at 500°C for 10 hrs. Use Davisson Grade 952 silica. Presieve to > 38 microns (400-0 mesh).

Impregnate the support with an aqueous solution of $Cu(NO_3)_2.xH_2O$, and $Cr(NO_3)_3.9H_2O$ using appropriate quantity to get incipient wetness (ca. 1.2 ml/g) with the desired loading of Cu and Cr.

Dry the catalyst precursor in an oven for 16 hours at 110°C.

The dried catalyst precursor is then calcined in air by raising its temperature at a heating rate of ca. 1°C/min to 500°C and holding for 24 hours.

Impregnate the Cu-Cr/SiO_2 with an aqueous solution of Co nitrate [$Co(NO_3)_2.6H_2O$] using an appropriate quantity to get incipient wetness with the desired loading of Co.

Dry the catalyst precursor in an oven for 5 hrs at 115°C with moderate stirring.

Calcine the dried catalyst in air by raising its temperature at a heating rate of ca. 1°C/min to 300°C and holding for 10 hrs.

Reduction Procedure before Reaction:

Heat the catalyst in inert gas to 120°C at a rate of 1°C/min then start adding hydrogen to give a concentration of 0.5% at the bed inlet. Raise the catalyst bed temperature to 165°C at a rate of ca. 30°C/hr. When the temperature of the bed has reached 160°C increase the hydrogen concentration in the carrier gas to 1.0%. As the reduction proceeds and the temperature rise begins to diminish, the inlet temperature may be raised to 200°C. The inlet hydrogen concentration can then be increased to about 3-5%, provided that the maximum temperature limit of 230°C is not exceeded. When the reduction appears to be complete the inlet temperature should be raised to 230°C and the inlet hydrogen concentration raised to ca. 20%.

Catalyst Prep #	CoW.10	Date Tech	Nov-07-94	Amount	100.0 g

Compound	Co	Fe	Ru	Al203
(%wt)	10	10	0.5	

Support	y-Alumina VISTA B	Amount	79.50 g
Particle Size	400 - 0 mesh	Treatment	500°C / 10 hrs
Metal I	Cobalt Nitrate	Amount	49.32 g
Metal II	Iron (III) Nitrate	Amount	72.31 g
Metal III Promotor Promotor	Ruthenium Nitrosylnitrate	Amount Amount Amount	1.79 g

PROCEDURE

Preparation — X — Incipient Wetness — Wet Impregnation

Ion Exchange — Other

Notes: Incipient wetness: aqueous solution Fe, Co, Ru/Ca. 1.2 ml/g

Dry catalyst precursor in an oven 110°C / 5 hrs/Calcine 300 °C 10 hrs.

Calcination — Temperature 300°C — Time 10 hrs

Notes:

CoW.10 **10 wt% Fe**
10 wt% Co
0.5 wt% Ru
γ-alumina

Ru promoted cobalt/iron impregnated on calcined γ-alumina

Preparation Procedure

Calcine γ-alumina at 500°C for 10 hrs. Use Vista B alumina. Presieve to >38 microns (400-0 mesh).

Impregnate the support with an aqueous solution of Fe nitrate [$Fe(NO_3)_3.9H_2O$], Co nitrate [$Co(NO_3)_2.6H_2O$] and Ru nitrosylnitrate [$Ru(NO)(NO_3)_3.2H_2O$] using appropriate quantities to get incipient wetness (ca. 1.2 ml/g) with the desired loading of Fe, Co, and Ru.

Dry the catalyst precursor in an oven for 5 hrs at 115°C with moderate stirring.

Calcine the dried catalyst in air by raising its temperature at a heating rate of ca. 1°C/min to 300°C and holding for 10 hrs.

Reduction Procedure before Reaction:

Reduce the catalyst in pure hydrogen flow of 3000cc/g/hr by heating at 1°C/min to 350°C and holding for 10 hrs.

Catalyst Prep #	CoW.11	Date Tech	Nov-07-94	Amount	100.0 g

Compound	Co	Fe	Ru	K	Al2O3
(%wt)	10	10	0.5	0.5	

Support	y-Alumina VISTA B	Amount	79.00 g
Particle Size	400 - 0 mesh	Treatment	500°C / 10 hrs
Metal I	Cobalt Nitrate	Amount	49.32 g
Metal II	Iron (III) Nitrate	Amount	72.31 g
Metal III		Amount	
Promotor	Ruthenium Nitrosylnitrate	Amount	1.79 g
Promotor	Potassium Nitrate	Amount	

PROCEDURE

Preparation — X Incipient Wetness — Wet Impregnation — Ion Exchange — Other

Notes: Incipient wetness: aqueous solution Fe, Co, Ru, K/ Ca. 1.2 g/ml
Dry catalyst precursor in an oven 115°C / 5 hrs/Calcine 300 °C 10 hrs.

Calcination — Temperature 300°C Time 10 hrs

Notes:

CoW.11 **10 wt% Fe**
10 wt% Co
0.5 wt% Ru
0.5 wt% K
γ-alumina

Ru and K promoted cobalt/iron impregnated on calcined γ-alumina

Preparation Procedure

Calcine γ-alumina at 500°C for 10 hrs. Use Vista B alumina. Presieve to >38 microns (400-0 mesh).

Impregnate the support with an aqueous solution of Fe nitrate [$Fe(NO_3)_3.9H_2O$], Co nitrate [$Co(NO_3)_2 6H_2O$], Ru nitrosylnitrate [$Ru(NO)(NO_3)_3.2H_2O$], and K nitrate [KNO_3] using appropriate quantities to get incipient wetness (ca. 1.2 ml/g) with the desired loading of Fe, Co, Ru, and K.

Dry the catalyst precursor in an oven for 5 hrs at 115°C with moderate stirring.

Calcine the dried catalyst in air by raising its temperature at a heating rate of ca. 1°C/min to 300°C and holding for 10 hrs.

Reduction Procedure before Reaction:

Reduce the catalyst in pure hydrogen flow of 3000cc/g/hr by heating at 1°C/min to 350°C and holding for 10 hrs.

Catalyst Prep #	CoW.12	Date Tech	Nov-07-94	Amount	100.0 g

Compound	Co	Fe	Ru	SiO2
(%wt)	10	10	0.5	

Support	Silica Davison Grade 59	Amount	79.50 g
Particle Size	400 - 0 mesh	Treatment	500°C / 10 hrs
Metal I	Cobalt Nitrate	Amount	49.32 g
Metal II	Iron (III) Nitrate	Amount	72.31 g
Metal III Promotor Promotor	Ruthenium Nitrosylnitrate	Amount Amount Amount	1.79 g

PROCEDURE

Preparation X Incipient Wetness Wet Impregnation

Ion Exchange Other

Notes Incipient wetness: aqueous solution Co, Fe, Ru

Dry catalyst precursor in an oven 115°C / 5 hrs/Calcine 300 °C 10 hrs.

Calcination Temperature 300°C Time 10 hrs

Notes

CoW.12 **10 wt% Fe**
10 wt% Co
0.5 wt% Ru
Silica

Ru promoted cobalt/iron impregnated on calcined silica

Preparation Procedure

Calcine silica at 500°C for 10 hrs. Use Davisson Grade 952 silica. Presieve to >38 microns (400-0 mesh).

Impregnate the support with an aqueous solution of Fe nitrate [$Fe(NO_3)_3.9H_2O$], Co nitrate [$Co(NO_3)_2 6H_2O$] and Ru nitrosylnitrate [$Ru(NO)(NO_3)_3.2H_2O$] using appropriate quantities to get incipient wetness with the desired loading of Fe, Co, and Ru.

Dry the catalyst precursor in an oven for 5 hrs at 115°C with moderate stirring.

Calcine the dried catalyst in air by raising its temperature at a heating rate of ca. 1°C/min to 300°C and holding for 10 hrs.

Reduction Procedure before Reaction:

Reduce the catalyst in pure hydrogen flow of 3000cc/g/hr by heating at 1°C/min to 250°C and holding for 10 hrs.