CLAIMS

1. A catalyst for methanation of carbon dioxide, the catalyst being formed by mixing ash from a biomass power plant with a nickel compound and calcining a resulting mixture, and the catalyst formed by calcination comprising between 2 and 20 wt. % of nickel; wherein the catalyst for methanation of carbon dioxide is prepared by a method, the method comprising the following steps:

    1) preparing an aqueous solution comprising between 5 and 30 wt. % of the nickel compound;

    2) calcining the ash from the biomass power plant at a temperature of between 300 and 400ºC for between 20 and 40 min for removing combustible impurities from the ash from the biomass power plant;

    3) calculating doses of raw materials according to a desired weight percent of nickel in a catalyst product, mixing the aqueous solution comprising the nickel compound with the ash from the biomass power plant after calcinations in step 2), and stirring a resulting mixture for between 5 and 10 h for uniformly impregnating the mixture;

    4) desiccating the ash from the biomass power plant after impregnation treatment at a temperature of between 110 and 150ºC for between 0.5 and 1.5 h; and

    5) calcining the ash from the biomass power plant after desiccation treatment at a temperature of between 400 and 450ºC for between 3 and 6 h and being screened to obtain particles having a particle size of between 40 and 60 meshes to yield the catalyst for methanation of carbon dioxide.

2. The catalyst of claim 1, **characterized in that** the catalyst formed in the calcination comprises between 5 and 15 wt. % of nickel.

3. The catalyst of claim 1, **characterized in that** the catalyst formed in the calcination comprises between 10 and 20 wt. % of nickel.

4. The catalyst of any one of claims 1-3, **characterized in that** the nickel compound is selected from the group consisting of nickel nitrate, nickel oxalate, nickel formate, nickel acetate, nickel citrate, nickel tartrate, and a mixture thereof.

5. The catalyst of any one of claims 1-3, **characterized in that** the ash from the biomass power plant is selected from ash collected in a bag dust collector and has an average particle size of between 10 and 15 μm.

6. The catalyst of claim 4, **characterized in that** an average particle size of the ash from the biomass power plant is between 10 and 15 μm.

~~7. A method for preparing the catalyst for methanation of carbon dioxide of claim 1, the method comprising the following steps:~~

~~1) preparing an aqueous solution comprising between 5 and 30 wt. % of the nickel compound;~~

~~2) calcining the ash from the biomass power plant at a temperature of between 300 and 400°C for between 20 and 40 min for removing combustible impurities from the ash from the biomass power plant;~~

~~3) calculating doses of raw materials according to a desired weight percent of nickel in a catalyst product, mixing the aqueous solution comprising the nickel compound with the ash from the biomass power plant after calcinations in step 2), and stirring a resulting mixture for between 5 and 10 h for uniformly impregnating the mixture;~~

~~4) desiccating the ash from the biomass power plant after impregnation treatment at a temperature of between 110 and 150°C for between 0.5 and 1.5 h; and~~

~~5) calcining the ash from the biomass power plant after desiccation treatment at a temperature of between 400 and 500°C for between 3 and 6 h to yield the catalyst~~

~~for methanation of carbon dioxide.~~

~~8~~ 7. The ~~method~~ catalyst of claim ~~7~~1, **characterized in that**

a calcination time in step 2) is controlled for between 25 and 30 min;

a stirring time in step 3) is controlled for between 6 and 8 h;

a desiccation time in step 4) is controlled for between 0.5 and 1.0 h; and

a calcinations time in step 5) is controlled for between 4 and 5 h.

~~9~~ 8. A method for using the catalyst for methanation of carbon dioxide of claim 1 for a hydrogenation reaction of carbon dioxide in a fixed bed reactor, **characterized in that** activation conditions of the catalyst are as follows:

a particle size of the catalyst is between 40 and 60 meshes;

a reaction pressure is normal pressure;

a molar ratio between feed compositions is $H_2/CO_2 = 4/1$;

a volume space velocity is between 5500 and 9000 h^{-1};

a reaction temperature is between 250 and 450°C; and

a reaction time is between 1 and 2 h.

~~10~~ 9. The method of claim ~~9~~8, **characterized in that** the activation conditions of the catalyst are as follows:

the particle size of the catalyst is between 40 and 60 meshes;

the reaction pressure is normal pressure;

the molar ratio between feed compositions is $H_2/CO_2 = 4/1$;

the volume space velocity is between 6000 and 8000 h^{-1};

the reaction temperature is between 350 and 400°C; and

the reaction time is 2 h.