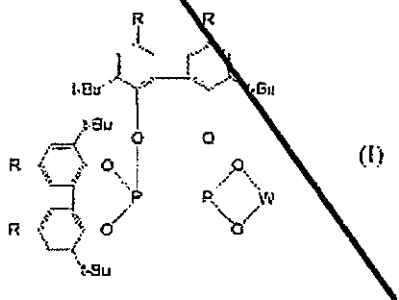
CLAIMS

[Claim 1]

A method for producing a dialdehyde, comprising reacting a linear olefinic compound having each of an ethylenic double bond and an aldehyde group on each end of the molecule with carbon monoxide and hydrogen in the presence of a rhodium catalyst comprised of a bisphosphite represented by General Formula (I) and a rhodium compound, wherein the reaction pressure of a mixed gas formed of carbon monoxide and hydrogen is decreased as the reaction proceeds:



(I)

wherein R represents a hydrogen atom, an alkyl group having 1 to 4 carbon atoms, or an alkoxy group having 1 to 4 carbon atoms, W represents an alkylene group having 1 to 20 carbon atoms, a cycloalkylene group having 5 to 18 carbon atoms, or an alkylene-arylene group having 7 to 11 carbon atoms.

[Claim 2]

The method for producing a dialdehyde according to claim 1, wherein the content of water in the reaction solution at a time of initiation of the reaction is 0.1 mmol/kg to 500 mmol/kg, and the content of a carboxylic acid in the reaction solution is 0.1 mmol/kg to 50 mmol/kg in terms of carboxyl groups.

[Claim 3]

The method for producing a dialdehyde according to claim 1 or 2, wherein the reaction pressure of a mixed gas formed of carbon monoxide and hydrogen is controlled stepwise or continuously to 30% to 80% of the pressure at a time of initiation of the reaction in a step in which the conversion of the linear olefinic compound having each of an ethylenic double bond and an aldehyde group on each end of the molecule is more than 70%.

[Claim 4]

The method for producing a dialdehyde according to claim 3, wherein a plurality of reactors are connected, the reaction is carried out in a first reactor until the conversion of the linear olefinic compound having each of an ethylenic

double bond and an aldehyde group on each end of the molecule is more than 70%, and then the reaction solution in the first reactor is transferred to a second reactor in which the reaction pressure of the mixed gas formed of carbon monoxide and hydrogen is 30% to 80% of one of the first reactor to successively carry out the reaction.

[Claim 5]

The method for producing a dialdehyde according to any one of claims 1 to 4, wherein the linear olefinic compound having each of an ethylenic double bond and an aldehyde group on each end of the molecule is any one of 5-hexen-1-al, 6-hepten-1-al, 7-octen-1-al, 8-nonen-1-al, 9-decen-1-al, 10-undecen-1-al, and 11-dodecen-1-al.

[Claim 6]

The method for producing a dialdehyde according to any one of claims 1 to 5, wherein a bisphosphite of General Formula (I), in which R is an alkyl group having 1 to 4 carbon atoms or an alkoxy group having 1 to 4 carbon atoms, and W is an alkylene group having 1 to 20 carbon atoms, is used.

[Claim 7]

The method for producing a dialdehyde according to claim 6, wherein using the bisphosphite, in which R is a t-butyl group and W is an alkylene group having 2 to 5 carbon atoms.

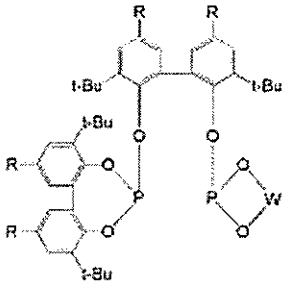
[Claim 8]

The method for producing a dialdehyde according to any one of claims 1 to 7, wherein the amount of rhodium to be used in the reaction solution is 1.0×10^{-4} mmol/kg to 6.0×10^{-1} mmol/kg in terms of rhodium atoms, the amount of bisphosphite to be used is 1 molar times to 100 molar times with respect to the rhodium atoms, the reaction temperature is 50°C to 130°C, the compositional ratio of carbon monoxide to hydrogen is carbon monoxide/hydrogen = 0.1/1 to 10/1 in terms of molar ratio, and the pressure at a time of initiation of the reaction is 0.5 MPa to 10 MPa (gauge pressure).

CLAIMS

[Claim 1]

A method for producing a dialdehyde, comprising reacting a linear olefinic compound having each of an ethylenic double bond and an aldehyde group on each end of the molecule with carbon monoxide and hydrogen in the presence of a rhodium catalyst comprised of a bisphosphite represented by General Formula (I) and a rhodium compound, wherein the reaction pressure of a mixed gas formed of carbon monoxide and hydrogen is decreased as the reaction proceeds:



(I)

wherein R represents a hydrogen atom, an alkyl group having 1 to 4 carbon atoms, or an alkoxy group having 1 to 4 carbon atoms, W represents an alkylene group having 1 to 20 carbon atoms, a cycloalkylene group having 5 to 18 carbon atoms, or an alkylene-arylene group having 7 to 11 carbon atoms.

[Claim 2]

The method for producing a dialdehyde according to claim 1, wherein the reaction solution at a time of initiation of the reaction comprises from 0.1 mmol/kg to 500 mmol/kg of water, and from 0.1 mmol/kg to 50 mmol/kg of a carboxylic acid in terms of carboxyl groups.

[Claim 3]

The method for producing a dialdehyde according to claim 1 or 2, wherein the reaction pressure of a mixed gas formed of carbon monoxide and hydrogen is controlled stepwise or continuously to 30% to 80% of the pressure at a time of initiation of the reaction in a step in which the conversion of the linear olefinic compound having each of an ethylenic double bond and an aldehyde group on each end of the molecule is more than 70%.

[Claim 4]

The method for producing a dialdehyde according to claim 3, wherein a plurality

of reactors are connected, the reaction is carried out in a first reactor until the conversion of the linear olefinic compound having each of an ethylenic double bond and an aldehyde group on each end of the molecule is more than 70%, and then the reaction solution in the first reactor is transferred to a second reactor in which the reaction pressure of the mixed gas formed of carbon monoxide and hydrogen is 30% to 80% of one of the first reactor to successively carry out the reaction.

[Claim 5]

The method for producing a dialdehyde according to any one of claims 1 to 4, wherein the linear olefinic compound having each of an ethylenic double bond and an aldehyde group on each end of the molecule is any one of 5-hexen-1-al, 6-hepten-1-al, 7-octen-1-al, 8-nonen-1-al, 9-decen-1-al, 10-undecen-1-al, and 11-dodecen-1-al.

[Claim 6]

The method for producing a dialdehyde according to any one of claims 1 to 5, wherein a bisphosphite of General Formula (I), in which R is an alkyl group having 1 to 4 carbon atoms or an alkoxy group having 1 to 4 carbon atoms, and W is an alkylene group having 1 to 20 carbon atoms, is used.

[Claim 7]

The method for producing a dialdehyde according to claim 6, wherein using the bisphosphite, in which R is a t-butyl group and W is an alkylene group having 2 to 5 carbon atoms.

[Claim 8]

The method for producing a dialdehyde according to any one of claims 1 to 7, wherein the amount of rhodium to be used in the reaction solution is 1.0×10^{-4} mmol/kg to 6.0×10^{-1} mmol/kg in terms of rhodium atoms, the amount of bisphosphite to be used is 1 molar times to 100 molar times with respect to the rhodium atoms, the reaction temperature is 50°C to 130°C, the compositional ratio of carbon monoxide to hydrogen is carbon monoxide/hydrogen = 0.1/1 to 10/1 in terms of molar ratio, and the pressure at a time of initiation of the reaction is 0.5 MPa to 10 MPa (gauge pressure).