process described relatively uneconomic. The long reaction time resulting from unpressurized conduct of the reaction is another serious disadvantage of both of these processes.

EP 0 890 569 discloses a process for the production of methyl methacrylate by direct oxidative esterification of methacrolein with methanol. EP 0 890 569 explicitly teaches here that a low water content of less than 2 % by weight, preferably less than 1 % by weight, in the methacrolein is essential for the oxidative esterification. The examples list exclusively reactions with water content below 0.8 % by weight. Furthermore, according to this teaching it is important that the total content of contaminants must be small. EP 0 890 069 therefore teaches oxidative production of methacrolein in the gas phase from isobutylene with oxygen, and then complicated dewatering of the methacrolein in a column.

Although EP 0 092 097 and DE 28 55 504 teach an alternative synthesis process for methacrolein in the liquid phase, in a process where propanal is reacted with formaldehyde, this process produces a large amount of water which according to the teaching of EP 0 890 569 renders this type of process unsuitable without complicated purification as precursor stage for the oxidative esterification of methacrolein to methyl methacrylate. The starting materials and by-products used in this process, for example dimeric methacrolein, also potentially exert a yield-reducing or detrimental effect in oxidative esterification, alongside the high water content: the product according to DE 28 55 504 comprises more than 5 % by weight of an aldol by-product which would be detrimental in oxidative esterification and would inevitably require complicated purification of the methacrolein.

In the light of the prior art, an object of the ~~present invention~~embodiments disclosed herein is therefore to provide a technically improved MMA production process which does not have the disadvantages of conventional processes.

A particular objective of the embodiments disclosed herein is to enable the production of MMA with a relatively low energy usage. Furthermore the process shall be carried out in a manner that provides a high level of protection of the environment, so that the quantities of wastes obtained are very small. A particular object of the embodiments disclosed herein~~present invention~~ is to improve the overall yield of MMA, based on the raw materials used, for example by discovering and combining individual reaction steps with high product selectivity.

Moreover, it should be possible to carry out the process with a very small number of steps, which should be simple and reproducible.

In addition, it should be possible to carry out the process by using relatively simple and inexpensive plant. Capital expenditure for the plant should accordingly be small. Maintenance of this plant should be simple and inexpensive.

Other objects not explicitly mentioned are apparent from the overall context of the description and claims hereinafter.

A process with all of the features of patent claim 1 achieves the abovementioned objects, and also achieves other objects which are not explicitly mentioned, but which are readily derivable or deducible

from the circumstances discussed in the introduction of this specification. Dependent claims 2 to 18 protect advantageous embodiments of the claimed MMA production process.

Accordingly, ~~the present invention provides~~in an aspect, there is provided a process for producing MMA, comprising the following steps:

A) producing methacrolein from propanal and formaldehyde and

B) reacting the methacrolein obtained in step A) in an oxidative esterification reaction to give MMA,

which is characterized in that the two steps A) and B) take place in a liquid phase at a pressure of from 2 to 100 bar, and step B) is carried out in the presence of a heterogeneous noble-metal-containing catalyst comprising metals and/or comprising metal oxides.

By virtue of the claimed process it is possible, in a manner that was not foreseeable, to provide an MMA production process which does not have the disadvantages of conventional processes. Surprisingly, it has been found here that, contrary to the general teaching of the prior art, steps A) and B) can also be combined without any complicated intervening purification or dewatering of the methacrolein, and lead to high methyl methacrylate yields.

In particular, MMA can be produced with relatively low energy usage. The process can moreover be carried out in a manner that provides a high level of protection of the environment, giving relatively small quantities of wastes and substantially increasing atom efficiency.

In particular, neither of the reaction steps A) and B) in the claimed process requires that additional water be introduced into the reaction mixture and then in turn removed, and overall reaction volumes and volume flow rates can therefore be kept low.

The process can moreover be carried out with relatively few steps, and these are simple and reproducible and proceed with relatively high space-time yields.

Catalyst requirement, in particular organic base requirement per metric ton of MMA produced, is moreover very small.

The process can moreover be carried out with relatively simple and inexpensive plant. Capital expenditure for the plant is low. Maintenance of this plant is simple and inexpensive.

In this context it should be stated that, in comparison with the processes according to the prior art, the number of return streams and the magnitude of these have been reduced.

The by-products produced can moreover be removed very simply from the reaction mixtures, and the overall process can therefore be carried out with high yield, without any need for complicated purification steps.