Increasing the number of rectification trays to produce improved technical acrylic acid quality then leads to increased global load loss in the column, which turns into increased temperature loss in the column and worsening sensitivity to polymerization.

Moreover, acrylic acid has the particularity of easily forming Michael addition derivatives, such as 3-acryloxypropionic acid, also called acrylic acid dimer. These compounds are heavy products that reduce the recovery yield by consuming monomeric acrylic acid.

Like free-radical polymerization, this covalent reaction to form Michael derivatives is greatly favored by temperature. Consequently, the use of columns with a high number of rectification trays to meet the quality requirements of the acrylic acid leads to drawbacks in terms of product loss, which can only be compensated for in part by additional high-temperature cracking of the Michael derivatives to regenerate the acrylic acid monomer.

Accordingly, there is a substantial need to achieve separation while reducing the number of theoretical rectification trays, both to reduce the risk of polymerization and the formation of Michael addition derivative products, since both of these side effects are favored by a higher temperature.

What is more, the removal of light impurities (mainly water and acetic acid) in a solvent-free method such as described in document EP 2,066,613 requires a recycling loop between the 2 columns whose flow rate is large and inversely proportional to the efficacy of the finishing column. Therefore, increasing the recycling flow rate to compensate for insufficient efficacy leads to extra energy consumption.

In an aspect, there is provided a method for recovering purified (meth)acrylic acid, in the absence of organic solvent, from a gaseous reaction mixture comprising (meth)acrylic acid obtained by gaseous phase oxidation of a (meth)acrylic acid precursor, comprising at least the following steps:

a) the gaseous reaction mixture is subjected to a dehydration without using an azeotropic solvent in a first distillation column called a dehydration column, leading to a flow from the top of which at least part is condensed and sent back to the dehydration column in the form of reflux, and to a flow from the bottom of which at least part is sent back as reflux into the lower part of the dehydration column to form a recirculation loop;

b) the flow from the bottom of the dehydration column is sent at least in part into a second distillation column called a finishing column, which can separate a flow from the bottom containing heavy compounds, and a flow from the top containing light compounds, of which at least part is sent back to the dehydration column;

said method being characterized in that:

i) the finishing column is equipped with a separating wall, the wall being connected with the upper done of the column in the top portion and not connected with the bottom of the column in the lower portion, thereby separating the column into two sections equipped with internal distillation elements that ensure gas-liquid contact, of which the lower space communicates with the space at the bottom of the column, and of which the headspace is separated into two sealed areas, said column being fed from a single side of the separating wall, and

ii) a gaseous flow rich in light compounds and comprising water is extracted at the top of the feed section, then recycled, after condensation, at least in part in the recirculation loop at the bottom of the dehydration column, and

iii) a flow of purified (meth)acrylic acid extracted in gaseous form from the finishing column at the top of the section located on the other side of the feed section, is drawn off after condensation, part of the condensed flow being sent back as liquid reflux at the top of the draw-off section.

In another aspect, there is provided a method for producing purified (meth)acrylic acid comprising at least the following steps:

A) at least one (meth)acrylic acid precursor is subjected to an oxidation in gaseous phase to form a gaseous reaction mixture comprising (meth)acrylic acid;

B) the gaseous reaction mixture is cooled;

C) the cooled gaseous reaction mixture is subjected to the (meth)acrylic acid recovery method as defined above.

The inventors have discovered that using a column equipped with a separating wall and using it in specific conditions, like a finishing column in the method of document EP 2,066,613, overcomes the previously cited drawbacks by leading to a significant energy gain during the purification of the acrylic acid while producing a better quality of technical acrylic acid.

When a distillation column is equipped with a separating wall, the wall being connected with the upper dome of the column in the top portion, and not connected with the bottom of the column in the lower portion, the column includes two sections of which the lower space communicates with the space at the bottom of the column and of which the headspace is separated into two sealed areas.

When the finishing column has this configuration, the inventors have discovered that the light compounds and water contained in the feed flow of the finishing column are removed more effectively from the feed section, and can be recycled at the bottom of the dehydration column in a lower flow rate recycling loop, while allowing the extraction of acrylic acid with improved purity at the top of the other section; and the flow of heavy products forming in the column's lower space is removed at the bottom of the finishing column.