

Mixer for mixing of liquids or suspensions
and method for mixing

5 The present invention relates to a mixer for mixing of liquids or suspensions and a method for mixing.

On the market there are since long different mixers consisting of an agitator which is driven by a motor in a cylindrical vessel. The means which achieve the stirring
10 may be one or several plane shovels or plates, a propeller or a turbine wheel. Such mixers have been used in many connections and for many different purposes.

According to the invention there is now proposed an
15 effective and space saving embodiment of a mixer. The mixer according to the invention is mainly characterized in that it comprises two mixing chambers provided each with an exterior inlet, a first chamber having a little volume in relation to a second chamber. The chambers are connected to
20 each other in such a way that the outlet of the first chamber is an inlet to the second chamber. A number of mixing elements are arranged on a rotating axis which is common for the two chambers. The mixing elements have different shape in the two chambers and the mixing elements
25 in the first chamber are arranged to achieve mixing by means of large shear forces, while the mixing elements in the second chamber are arranged to achieve mixing through stirring mainly without shear forces.

30 With a mixer of such design there is obtained two different kinds of mixing with only one driving means.

The high shear forces which are needed for the mixing in the first chamber demand a high addition of energy.

With advantage the first chamber is arranged above the second chamber, since the bearing of the rotating axis in the larger lower chamber gives a smaller influence on the flow conditions in the same. If so is desired the first
5 smaller chamber may, however, be arranged below the second chamber. Providing the mixer with a vertical stirring axis means that the demand of space is little.

10 In order to achieve the desired high shear forces in the first chamber the mixing elements in the same suitably consists of turbine wheels with shovels. Depending on the capacity of the mixer may 4, 6 or more shovels be used. Also other kinds of mixing elements which give rise to high shear forces may of course be used.

15 The mixing elements in the second chamber consist with advantage of impeller formed agitators which give a little increase in pressure.

20 With advantage as well the upper as the lower chamber are provided with flow disturbing baffle plates at the walls of the mixing chamber. These plates are preferably arranged radially in the respective chamber with an extension of ~ 1/10 of the diameter of the mixing chamber.

25 Both the upper and the lower mixing chamber are suitably also provided with annular horizontal plates arranged between the mixing elements. These plates divide the mixing chambers in a number of partial spaces where separate
30 vortex formations occur.

The mixer according to the invention is with advantage provided with a motor with variable rotation speed which drives the rotating axis. By way of such an arrangement the

mixer may easily be adapted to different kinds of mixing tasks.

5 The invention also comprises a method for continuous mixing of a small amount of a first liquid with a considerably larger amount of a second liquid in a mixer of the kind which has been described above. The first liquid is mixed with the second liquid in a first mixing chamber in which the mixing takes place by means of high shear forces, after
10 which the obtained mixture in a second mixture chamber is subjected to mixing by stirring mainly without shear forces.

The method according to the invention is suitable for
15 degumming, refining or other treatment of vegetable oils. In such a treatment the first liquid is a chemical additive as for example an acid, a caustic solution or anti-oxidant while the second liquid consists of vegetable oil.

20 The method is suitably carried through in such a way that a chemical additive is mixed with a partial flow of vegetable oil in the first mixing chamber while the remaining amount of vegetable oil is added in the second chamber.

25 With advantage the degumming of oil may be carried through such that the desired amount of acid is mixed with the whole flow of vegetable oil in the first mixing chamber while the caustic solution which shall neutralize acid and fatty acids is added into the obtained mixture in the
30 second mixing chamber.

The mixer according to the invention is described further with reference to the attached drawings, fig 1 of which

shows one as an example chosen embodiment of a mixer while fig 2 shows an arrangement in which the mixer is a part.

In fig 1 there is shown a mixer 1 comprising two
5 cylindrical mixing chambers 2, 3. Above these chambers
there is a motor 4. Connected to and driven by the motor
there is a vertical axis 5 which in a manner which is not
shown is mounted in bearings at the bottom of the chamber
3. On the common axis 5 there are mixing elements 6 and 7.
10 In the upper mixing chamber 2 the mixing elements 6 consist
of turbine wheels with showels. In the embodiment of the
mixer that is shown there are two mixing elements in the
upper chamber and three in the lower. Depending on the
desired capacity of the mixer of course the number of
15 mixing elements may vary. The mixing elements 7 in the
lower mixing chamber have propeller shape and have as is
seen on the drawing been arranged to give upwards and
downwards flow in the mixing chamber alternatively. Along
the walls of the mixing chambers there are radially
20 arranged baffle plates 8, 9. The plates which extend
radially inwards are arranged with a certain opening gap
from the wall of the chamber. Their length is the same as
the height of the mixing chamber. The width is usually
~ 1/10 of the diameter of the mixing chamber. The mixing
25 chamber 2 has an inlet 10 and an outlet 11 which
constitutes the inlet into the mixing chamber 3. This has a
further inlet 12. In the bottom of the mixing chamber 3
there is an outlet 13. In both mixing chambers there are
annular horizontal plates 14, 15 which divide the mixing
30 chambers in a number of partial spaces. These partial
spaces make the presence of separate vortex formations
possible which facilitate the mixing.

With the shown embodiment of the mixer completely different flow conditions may be obtained in the two mixing chambers despite the fact that the common axis is rotating with a certain rotation speed. The energy which is added to the upper mixing chamber and gives rise to the high shear forces may be around 20 times larger than the addition of energy in the lower mixing chamber.

The diameter of the turbine wheel may be 140-190 mm with a diameter of 300 mm in the upper mixing chamber. The diameter of the propeller may be 160-250 mm at a diameter of 500 mm in the lower treatment chamber.

In fig 2 there is shown how the mixer according to the invention may be used for a mixing task in connection with treatment of vegetable oil.

Vegetable oil is led to the mixer 1 from a source 16 by way of a conduit 17 in which there is a flow controlling valve 18. The conduit 17 leads to the upper mixing chamber 2. A chemical additive is added to the conduit 17 from a source 19 by way of a conduit 20. The mixture of vegetable oil and chemical additive which enters the treatment chamber 2 is subjected to such high shear forces that the additive very rapidly is divided into and reacts with the vegetable oil. From the treatment chamber 2 the obtained mixture passes down to the lower mixing chamber 3. To this a further amount of vegetable oil is added through the conduit 21. Also in this conduit there is a flow controlling valve 22. In the lower treatment chamber 3 the added vegetable oil is mixed with the mixture from the mixing chamber 3 by stirring. After mixing the oil is led further for further treatment through a conduit 23.

As is seen in the drawing chemical addition may take place also to the treatment chamber 3 if it should be desirable.

If the treatment that shall be carried through of the vegetable oil consists of a degumming the additive consists of some acid as citric acid, phosphoric acid or sulphuric acid which are added in an amount of 0.05 - 0.20 % of the vegetable oil. The addition of acid is accompanied by an addition of caustic solution in an amount of 0.1 - 15 % of the flow of vegetable oil. This addition may take place either in a further mixer or at relatively low flows in that the acid is added to the upper mixing chamber and caustic solution to the lower mixing chamber in the same mixer.

The method according to the invention may also be used at other additions to the vegetable oil as an addition of anti-oxidant (end treatment) or in connection with hardening of the oil when a catalyzer is added in the form of a suspension.

When treating according to the invention the chemical additive may be used efficiently which may lead to a lower use of chemicals which brings about lower costs for the producer. With the effective mixing the holding time in the mixer may be short - below 30 seconds.

Claims

1. Mixer for mixing of liquids or suspensions, c h a -
r a c t e r i z e d i n t h a t i t c o m p r i s e s t w o m i x i n g
5 c h a m b e r s (2 , 3) e a c h p r o v i d e d w i t h a n e x t e r i o r i n l e t
(1 0 , 1 2) , a f i r s t c h a m b e r (2) h a v i n g a l i t t l e v o l u m e i n
r e l a t i o n t o a s e c o n d c h a m b e r (3) , w h i c h c h a m b e r s a r e
c o n n e c t e d t o e a c h o t h e r i n s u c h a w a y t h a t t h e f i r s t
c h a m b e r (2) l e a d s t o t h e s e c o n d c h a m b e r (3) a n d a n u m b e r o f
1 0 m i x i n g e l e m e n t s (6 , 7) a r r a n g e d o n a r o t a t i n g a x i s (5) w h i c h
i s c o m m o n f o r t h e t w o c h a m b e r s , w h i c h m i x i n g e l e m e n t s h a v e
d i f f e r e n t s h a p e s i n t h e t w o c h a m b e r s , a t w h i c h t h e m i x i n g
e l e m e n t s (6) i n t h e f i r s t c h a m b e r (2) a r e a r r a n g e d t o
a c h i e v e a m i x i n g b y m e a n s o f l a r g e s h e a r f o r c e s w h i l e t h e
1 5 m i x i n g e l e m e n t s (7) i n t h e s e c o n d c h a m b e r (3) a r e a r r a n g e d
t o a c h i e v e a m i x i n g b y s t i r r i n g m a i n l y w i t h o u t s h e a r
f o r c e s .
2. Mixer according to claim 1, c h a r a c t e r i -
2 0 z e d i n t h a t t h e f i r s t c h a m b e r (2) i s a r r a n g e d a b o v e
t h e s e c o n d c h a m b e r (3) .
3. Mixer according to claim 1-2, c h a r a c t e r i -
z e d i n t h a t t h e m i x i n g e l e m e n t s (6) i n t h e f i r s t
2 5 c h a m b e r c o n s i s t s o f a t u r b i n e w h e e l w i t h s h o v e l s .
4. Mixer according to claim 1-3, c h a r a c t e r i -
z e d i n t h a t t h e m i x i n g e l e m e n t s (7) i n t h e s e c o n d
c h a m b e r c o n s i s t s o f p r o p e l l e r f o r m e d a g i t a t o r s .
3 0
5. Mixer according to claim 1-4, c h a r a c t e r i -
z e d i n t h a t a s w e l l t h e u p p e r a s t h e l o w e r c h a m b e r a r e
p r o v i d e d w i t h f l o w d i s t u r b i n g b a f f l e p l a t e s (8 , 9) a t t h e
w a l l s o f t h e m i x i n g c h a m b e r .



5 6. Mixer according to claim 1-5, c h a r a c t e r i -
z e d i n that as well the upper as the lower chamber by
way of annular horizontal plates (14,15) arranged between
the mixing elements are divided into a number of partial
spaces where separate vortex formations are obtained.

10 7. Mixer according to any of the preceding claims,
c h a r a c t e r i z e d i n that the rotating axis is
driven by a motor (4) with a variable rotation speed.

15 8. Method for continuous mixing in a mixer according to
claim 1, c h a r a c t e r i z e d i n that a little
amount of a first liquid is mixed with a considerably
larger amount of a second liquid in a first mixing chamber
in which the mixing takes place by way of high shear
forces, after which the obtained mixture in a second mixing
chamber is subjected to mixing by stirring mainly without
shear forces.

20 9. Method according to claim 8, c h a r a c t e r i -
z e d i n that the first liquid consists of a chemical
additive as for example acid, caustic solution or
antioxidant, while the second liquid consists of vegetable
oil.

25 10. Method according to claim 8-9, c h a r a c t e -
r i z e d i n that a chemical additive is mixed with a
partial flow of vegetable oil in the first mixing chamber,
while the remaining amount of vegetable oil is added in the
30 second chamber.

11. Method according to claim 8-10, c h a r a c t e -
r i z e d i n that a chemical additive as an acid is
mixed with the total flow of vegetable oil in the first



mixing chamber, while a second chemical additive as caustic solution is added to the obtained mixture in the second mixing chamber.