TAH Mixing Applications Guide

MOTIONLESS SPIRAL MIXERS

How do they work?

TAH 'spiral-core' motionless mixer geometry is based on the original design concept developed by Arthur J. Little back in the 1960's. However in the early 80's the design was further improved by TAH to handle two component high viscosity applications specifically for the adhesives and sealants industry.

The TAH original 'statatube' design was created (early-70's) for the low viscosity , waterlike applications as commonly seen in many applications as found in the CPI and Water Wastewater Treatment Industries.

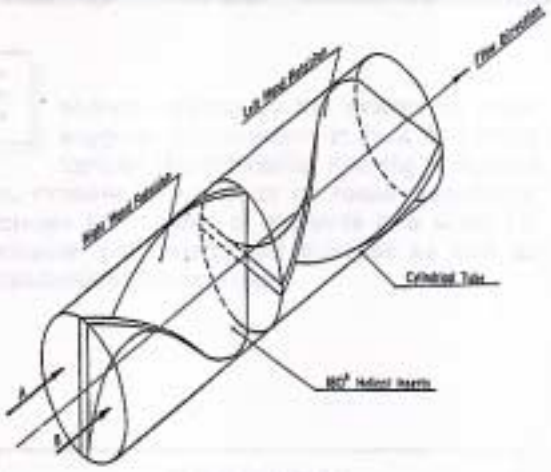
Static mixers have been patented as far back as 1895. Chemical Industrial companies such as Dow Chemical came up with their own designs to solve problems such as efficiently dispersing Titanium dioxide and silicates with a viscous polymer prior to spinning it into textile fibres.

IF YOU CAN PUMP IT,
YOU CAN MIX IT.

Motionless mixers are low shear , continuous inline units which can just about mix anything that can be pumped, to whatever consistency required.

FIT IT ,
AND FORGET IT.

Motionless mixers as compared to dynamic mixing devices are maintenance free and have no external power sources to rely upon except for the pump to overcome pressure losses in the mixer.

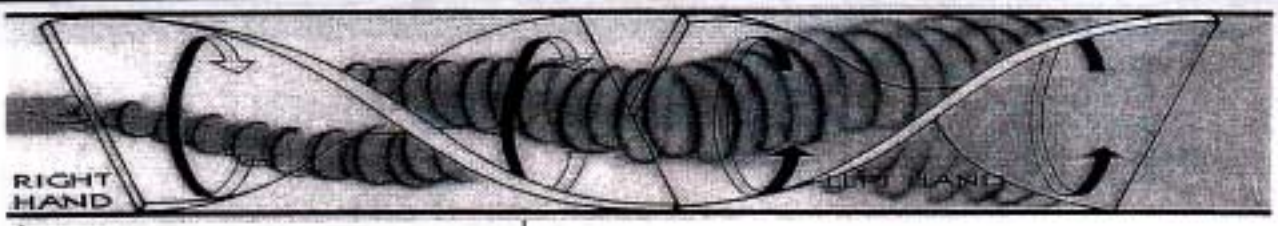


The motionless mixer has been shown considerable interest by the chemical process, and related industries. There is a need for devices which readily facilitate the uniform mixing of different fluid type phases, different powdered or granular-type materials, or indeed combinations of fluids, gases and solid-like materials. With this need particular interest has been shown by academia and industry alike for motionless mixing technology especially for continuous processing systems.

Motionless mixers such as the TAH spiral-core mixer rely on the sequential splitting of the two components, A & B, to be mixed with recombination arranged systematically by the nature of the flow ducting.

A particularly succesful yet deceptively simple mixer is the spiral geometry. Metallic or composite strips are twisted through 180 degrees to form helical elements of either right-hand or left-hand rotation. Alternate right- and left-hand elements are joined so that their respective leading and trailing edges are mutually perpendicular .

TAH Mixing Guide cont'd



The assembly of the elements is inserted axially inside a tube which has a bore diameter nominally equal to the width of the elements.

If two fluids, respectively designated A and B, are separately injected into the semicircular passage formed on either side of the first element, then the two streams rotate due to the physical constraint of the helix as they flow along the tube.

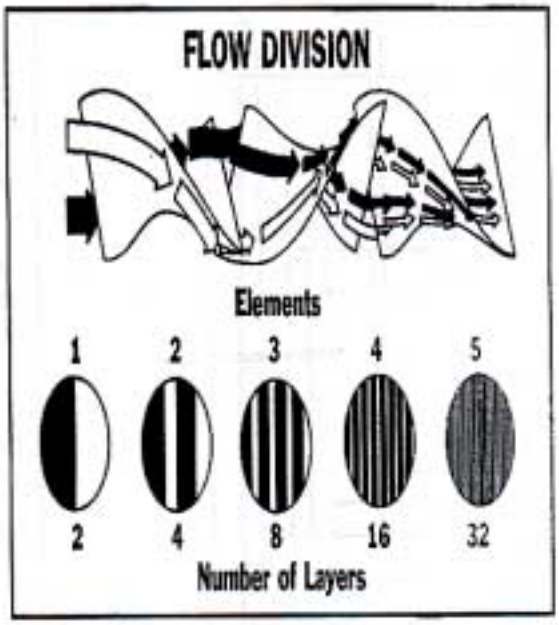
In the first element, therefore, half of the total channel cross-section is filled with fluid A and the other with fluid B. On entering the second element each semicircular stream is split due to the perpendicular orientation of adjacent elements so that two layers , one of A and one of B, flow in both passages of the second element. *Also note how the flow rotates in the opposite direction due to the left hand orientation of the second helix*

This process is repeated at the interface between adjacent elements so that the number of layers of both fluids in each semicircular passage is doubled by each element.

Therefore a mixer containing 10 elements would produce 2^{10} (1024) alternate layers of fluids A and B in each semicircular passage at exit from the mixer.

These layers of fluid become sufficiently thin in practice to produce virtually perfect plug flow mixing.

Enhanced mixing by the motionless mixer suggests improvement in heat and mass transfer characteristics. Keeping in mind as you increase flow rate, or decrease diameter or increase the number of elements in a string the pressure drop energy will increase as well as mixedness of the exit fluids.



TAH Mixing Guide contd

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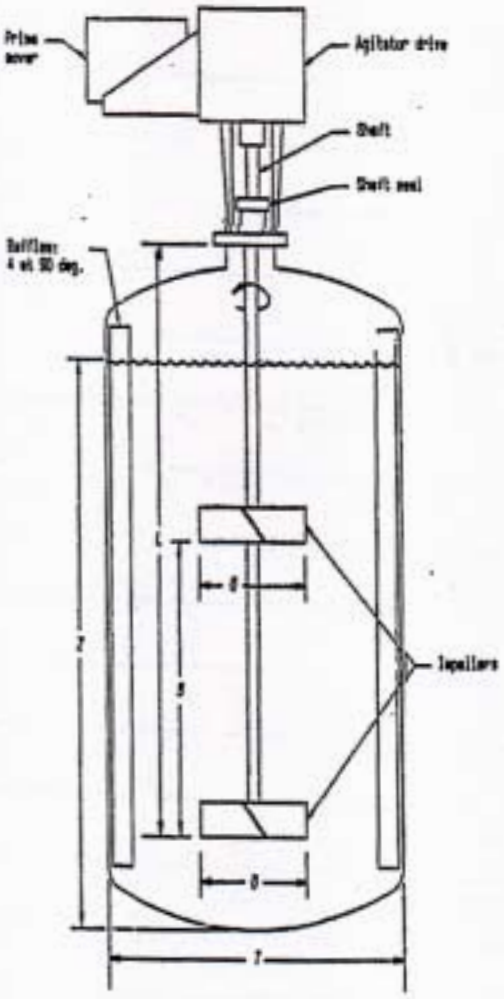
Analogous to dynamic impeller/shaft mixers more commonly seen in the process industries we can relate mixedness to Blend Times and Tank turnover rates.

DYNAMIC MIXER

Because of the backflow nature of a dynamic mixer we can take the volume of the fluid (gallons) in the tank and divide by the fluid pumping capacity (gallons per minute) exiting the impeller to calculate the time (minutes) required for one tank turnover . Typically in majority of cases the time required to achieve 12 tank turnovers is considered a good blend time.
Some applications may require more or less turnovers depending on process, residence times and types of impellers used.
In this mixing system random motion occurs as well as hydraulic instability . Number of striations is difficult to predict as well as what fraction of flow exerted by the impeller actually goes into, pumping verses shear energy.

In the end degree of mixedness is QUALITATIVE and in recent years with advances in technology mixing has arrived at a SCIENTIFIC approach for both dynamic and static mixers.

Ask yourself these questions.....
Did you get a mixer to perform the mixing required in your process ? How do you measure mixedness or degree of mixing in your particular process ?
You may have too much mixing or maybe too little mixing, can you tell by how much ?



References:
1)An experimental investigation of Mass Transfer and Flow Resistance in the Kenics Static Mixer... Morris & Mission, IECPDD Vol13No.3.1974
2)AICHE Equipment Testing Procedure-Mixing Equipment, 1987