VISIMIX LAMINAR.
HOMOGENIZING OF NON-NEWTONIAN COMPOSITION WITH HIGH-SHEAR IMPELLER.

Mixing tank:
Bottom type – elliptical,
Inside diameter – 36 in,
Total height – 40 in,
Height of media – 30 in.

Tank entering table is shown in the Figure 1.

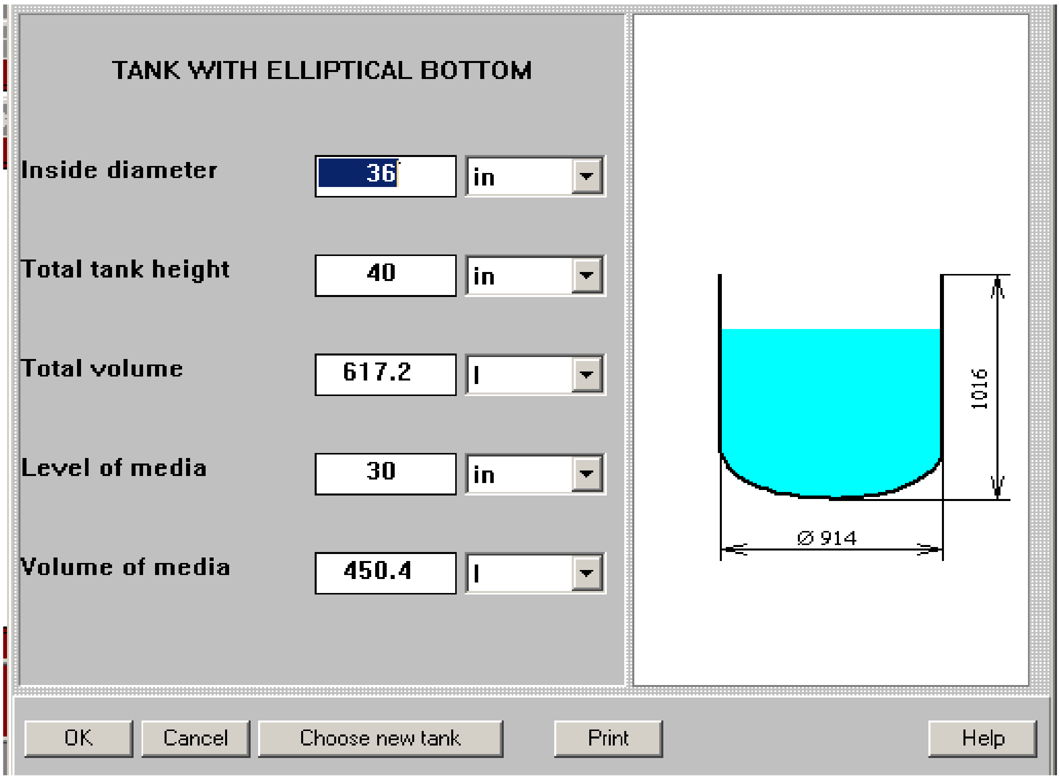


Figure 1. Input of the Tank sizes.

Impeller: a tooth-disk impeller with tangential teeth – see Figure 2.
The media is a viscous non-Newtonian mixture with the following properties:

Density	1200 kg/cub. m
Rheological constant, K	15 $Pa*s^{1-m}$
Rheological exponent, m	0.3
Yield stress, τ_0	6 N/m^2

The corresponding VisiMix input table is shown in the Figure 3.

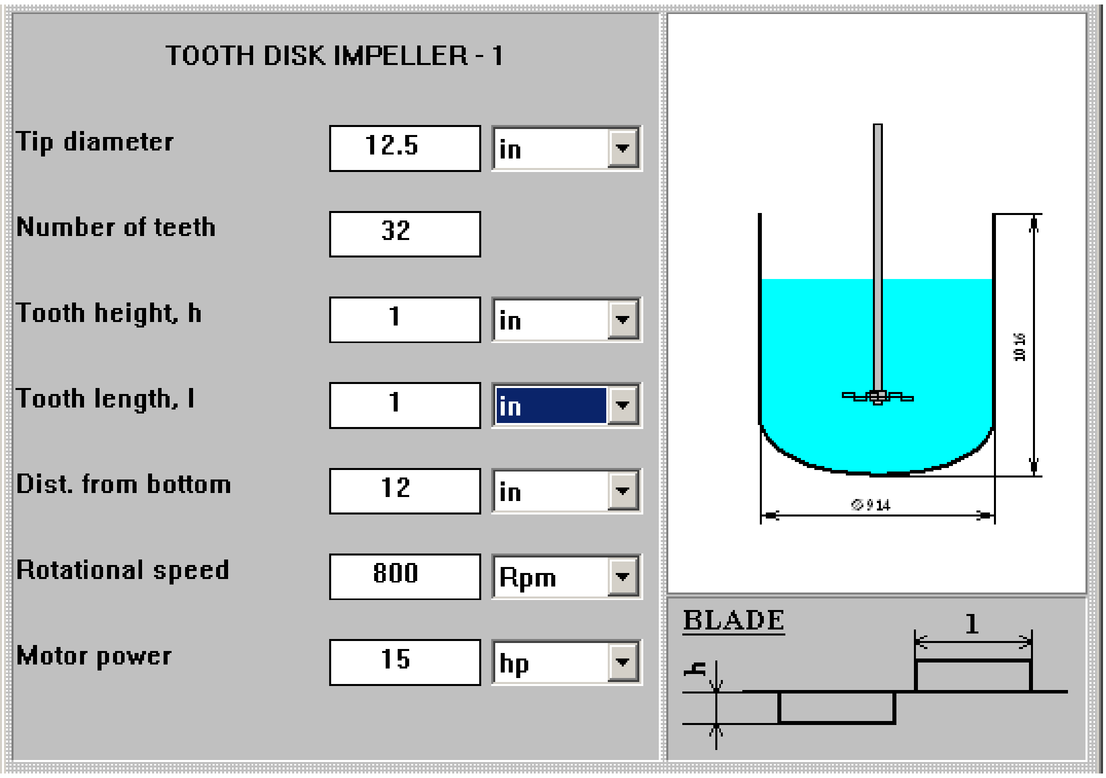


Figure 2. Input of impeller parameters.

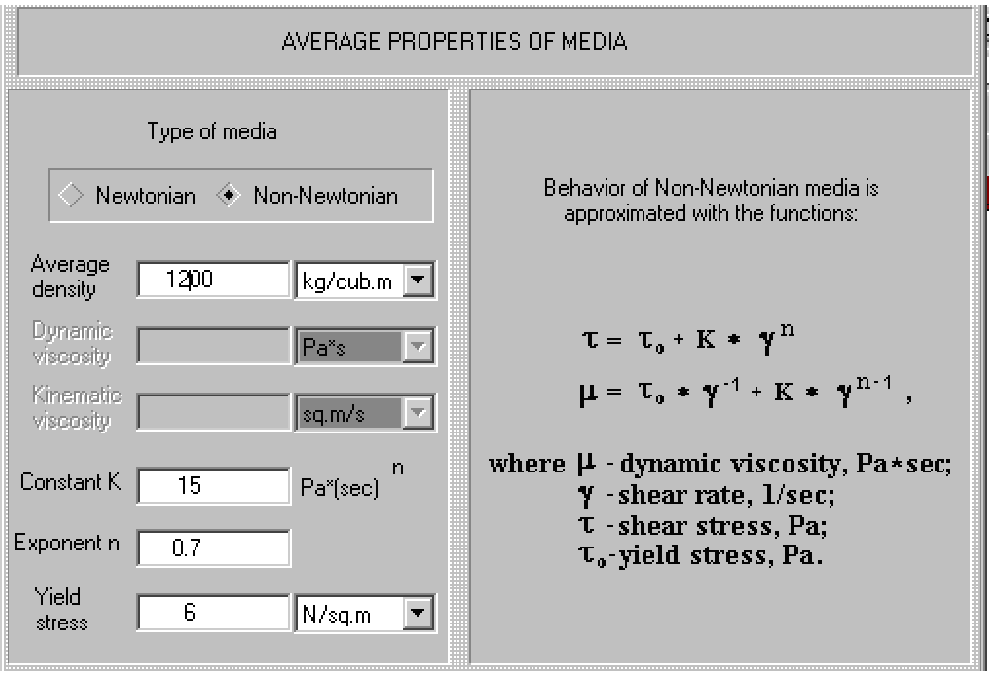


Figure 3. Entering rheological parameters on non-Newtonian liquid.

Some results of VisiMix modeling.

1. Mixing power and torque – Figures 4 - 6.

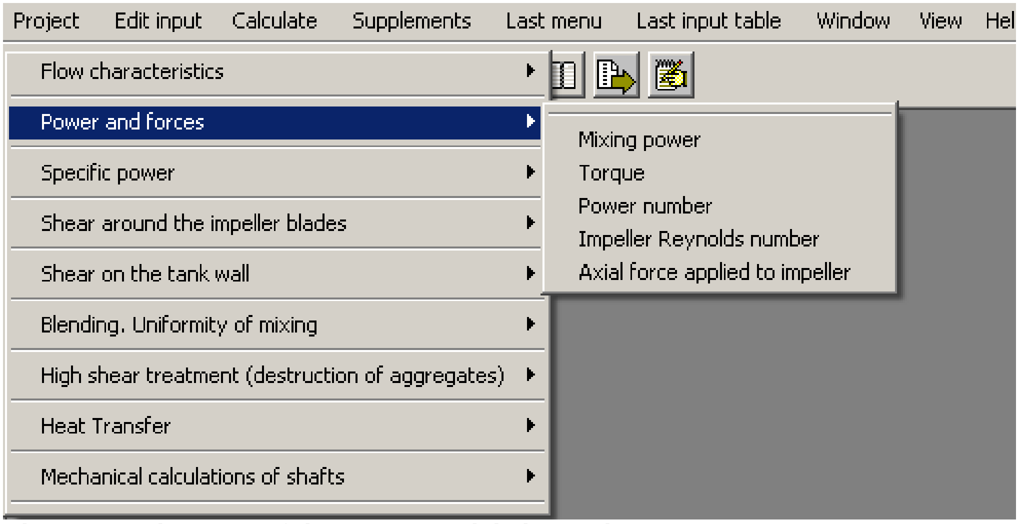
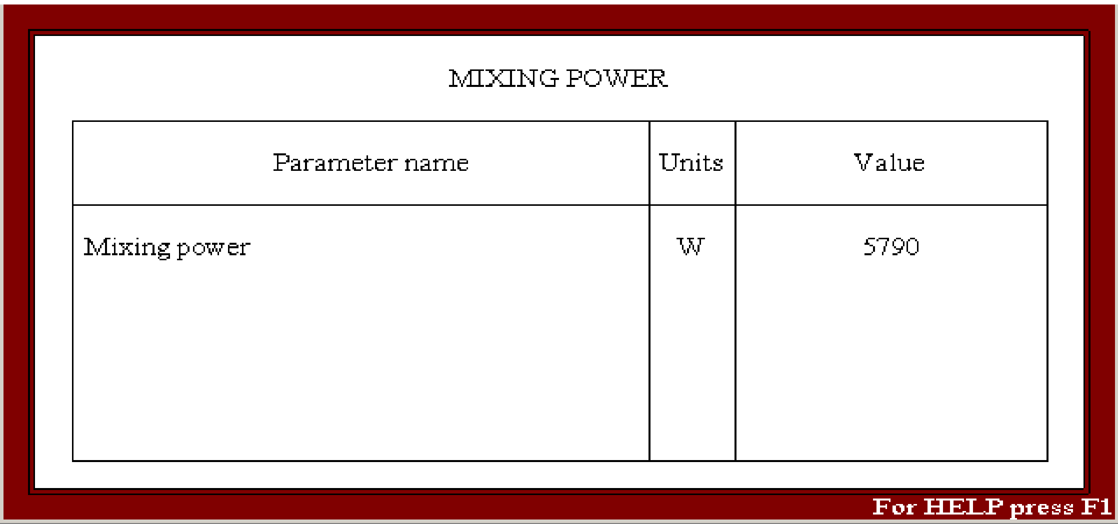


Figure 4. Main menu of the program VisiMix Laminar.



MIXING POWER

Parameter name	Units	Value
Mixing power	W	5790

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Figure 5. Calculated value of mixing power.

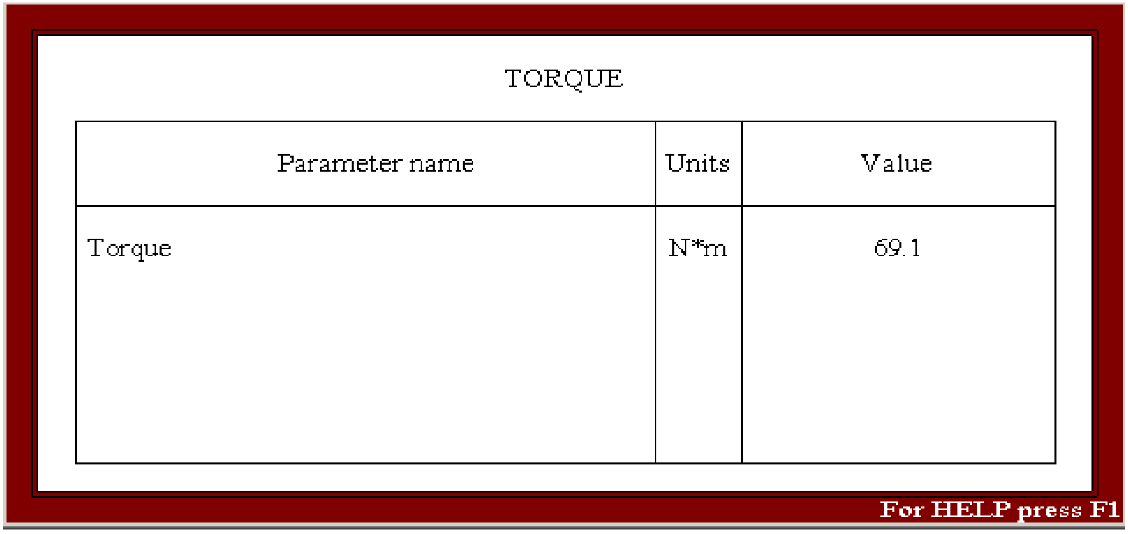

Figure 6. Calculated value of torque moment.

2. Calculation of shear characteristics in zone around the blades – see Figures 7-10.

Figure 7. Sub-menu of shear parameters in the impeller zone.

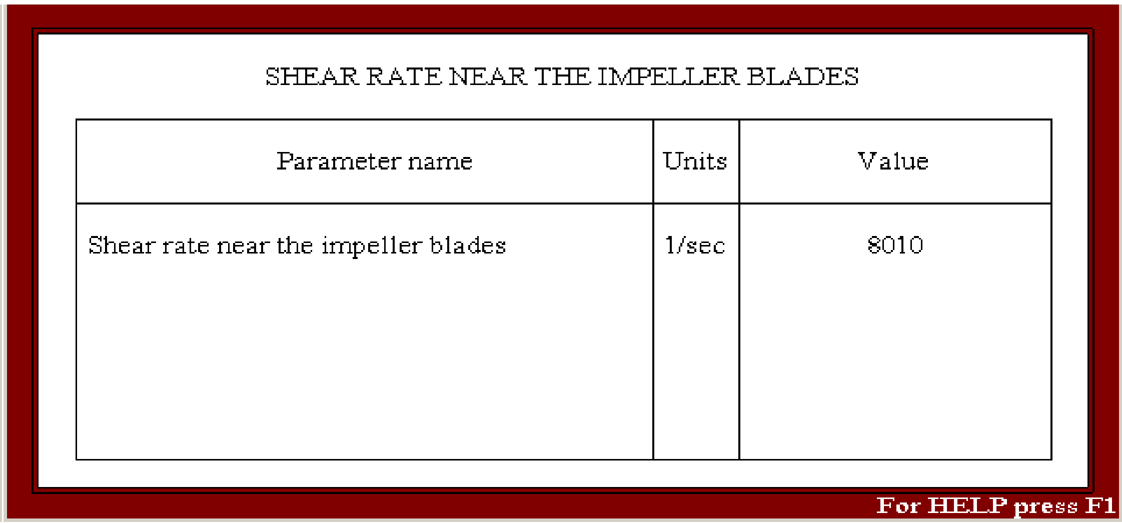

Figure 8. Maximum shear rate in the impeller zone.

EFFECTIVE VISCOSITY NEAR THE IMPELLER BLADES

Parameter name	Units	Value
Effective viscosity near the impeller blades	Pa*s	1.01

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Figure 9. Local effective viscosity in the impeller zone.

SHEAR STRESS NEAR THE IMPELLER BLADES

Parameter name	Units	Value
Shear stress near the impeller blades	N/sq.m	8110

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Figure 10. Maximum shear stress in the impeller zone.

3. Calculation of shear on the tank wall – see Figures 11 - 14.

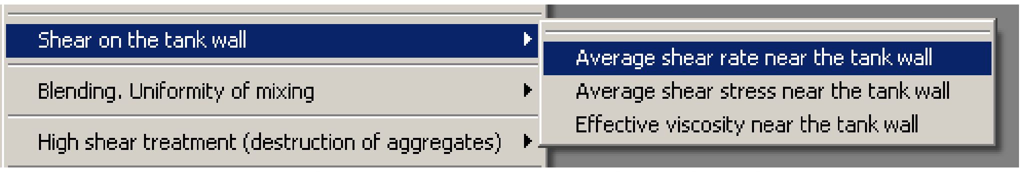

Figure 11. Sub-menu of shear characteristics on the tank wall.

AVERAGE SHEAR RATE NEAR THE TANK WALL

Parameter name	Units	Value
Average shear rate near the tank wall	1/sec	9.17

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Figure 12. Shear rate on the tank wall.

EFFECTIVE VISCOSITY NEAR THE TANK WALL

Parameter name	Units	Value
Effective viscosity near the tank wall	Pa*s	8.37

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Figure 13. Effective viscosity on the tank wall.

AVERAGE SHEAR STRESS NEAR THE TANK WALL

Parameter name	Units	Value
Average shear stress near the tank wall	N/sq.m	76.7

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Figure 14. Shear stress on the tank wall.

4. Mathematical modeling of mixing dynamics.

Expected mixing duration- 30 min. Figure 15.

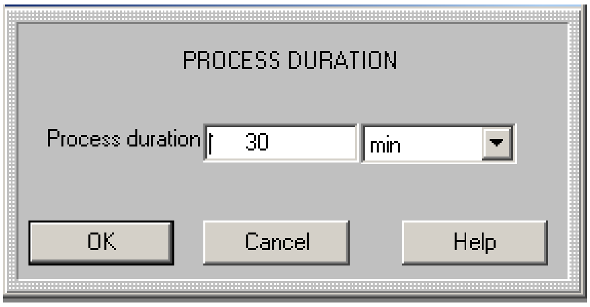


Figure 15. Entering mixing duration.

Results of mathematical modeling of blending – Figures 16 - 18.

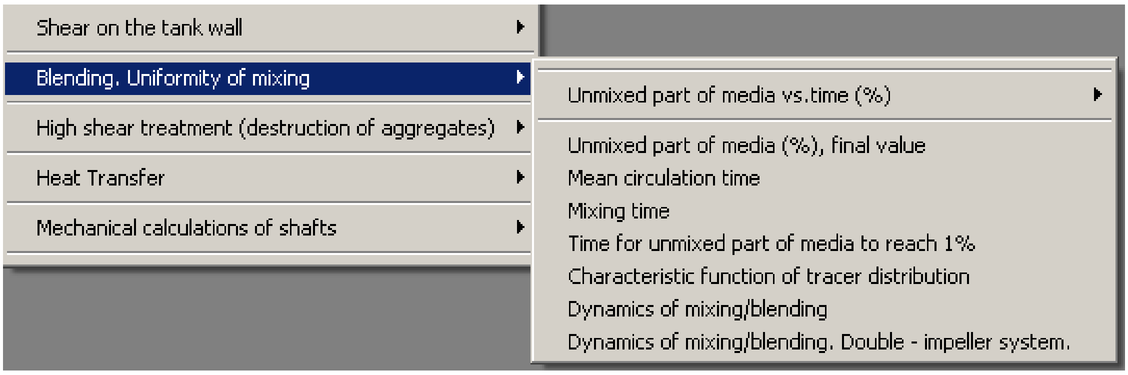


Figure 16. Sub-menu of macro-scale mixing (blending).

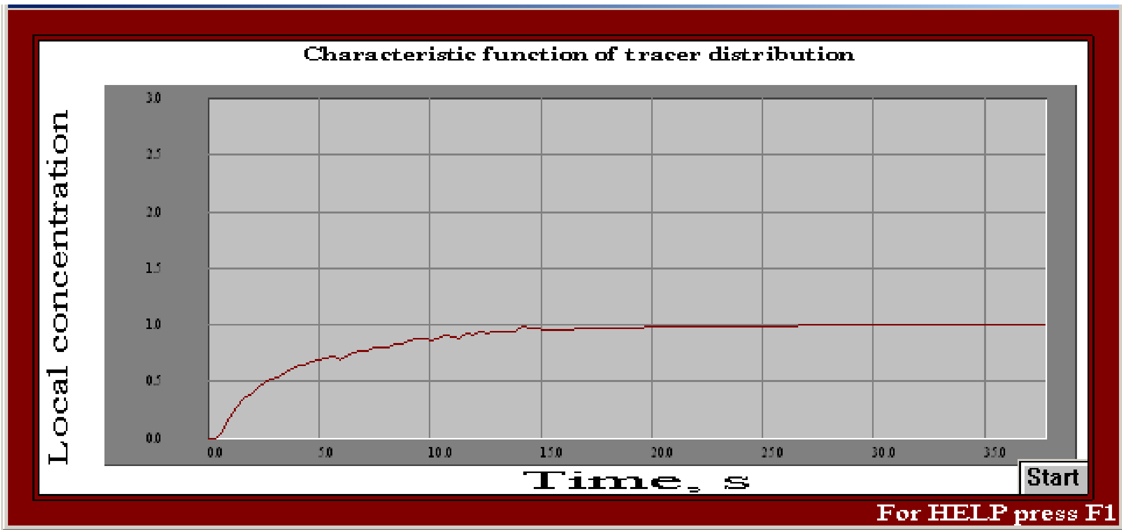
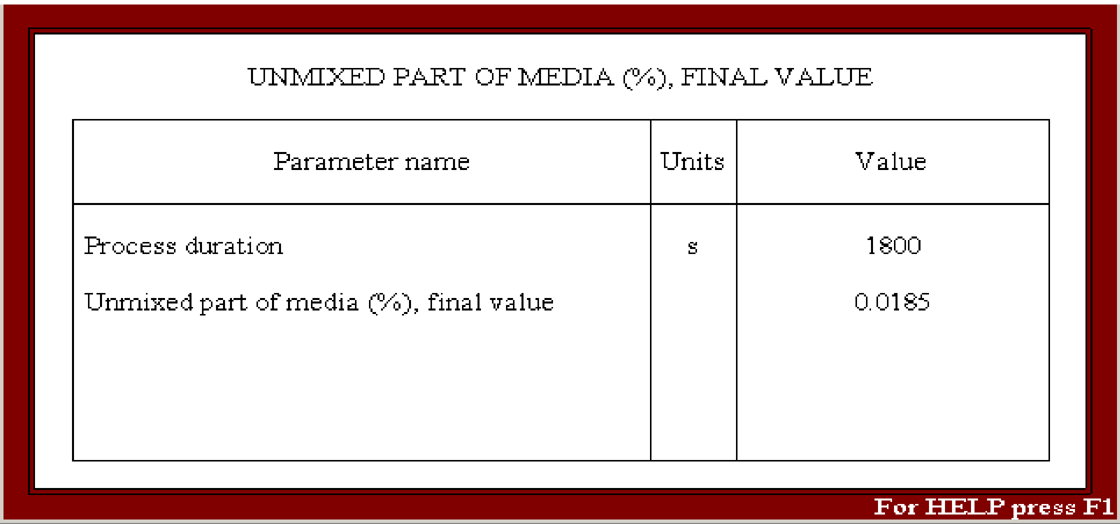


Figure 17. Macro-scale mixing dynamics.



UNMIXED PART OF MEDIA (%), FINAL VALUE

Parameter name	Units	Value
Process duration	s	1800
Unmixed part of media (%), final value		0.0185

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Figure 18. Completeness of mixing (stochastic evaluation).

High shear treatment of mixture in impeller zone (homogenizing) – Figures 19-21.

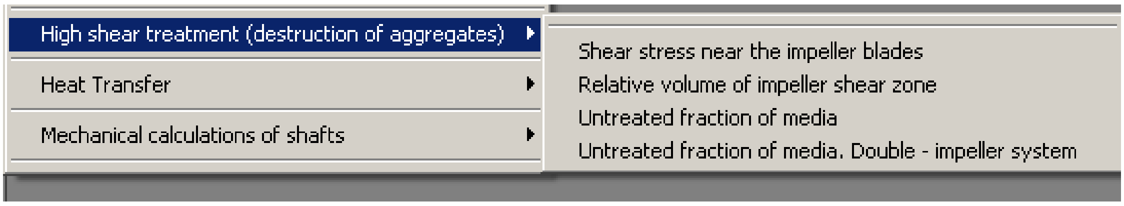
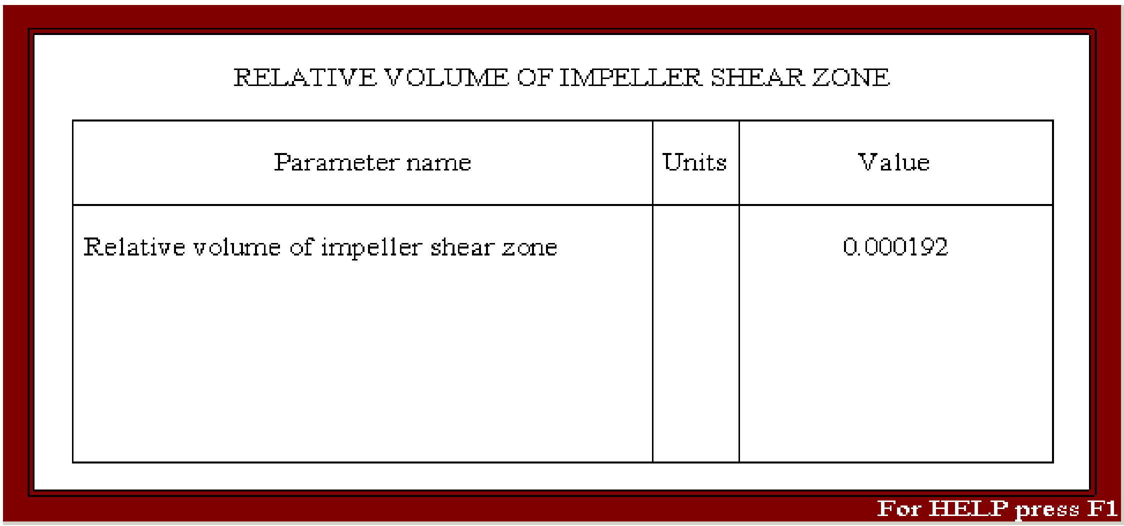


Figure 19. High shear treatment sub-menu.



RELATIVE VOLUME OF IMPELLER SHEAR ZONE

Parameter name	Units	Value
Relative volume of impeller shear zone		0.000192

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Figure 20. Relative volume of the maximum shear zone.

UNTREATED FRACTION OF MEDIA

Parameter name	Units	Value
Untreated fraction of media (%), less than 1 cycle of treatment		0.000498
Untreated fraction of media (%), less than 2 cycles of treatment		0.00659
Untreated fraction of media (%), less than 5 cycles of treatment		0.659

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Figure 21. Fraction of media that is blended but not completely homogenized in the high shear zone (stochastic evaluation).