VisiMix DI.

Mixing of non-Newtonian Liquids in Tanks with Different Impellers on the Shaft.

Mechanical Calculations of a Shaft with End Bearing.

1. Equipment description and initial data:

Tank application: preparation of a washing&cleaning liquid with micro-disperse solid abrasive.

Tank type: a fully baffled tank with flat bottom and 4 baffles.
Mixing device: 3-stage device that includes a disc turbine and two pitch paddle impellers.

Design and main dimensions are shown below in Figures 1 and 2.

Media: suspension with non-Newtonian properties. Density and rheological constants of the media are presented in the Figure 3.

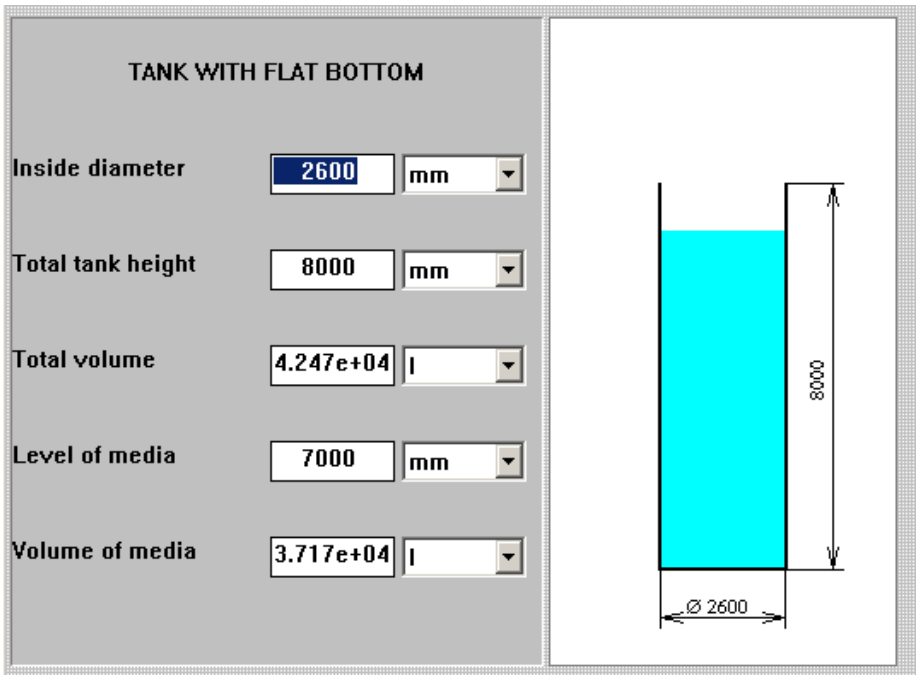


Figure 1.

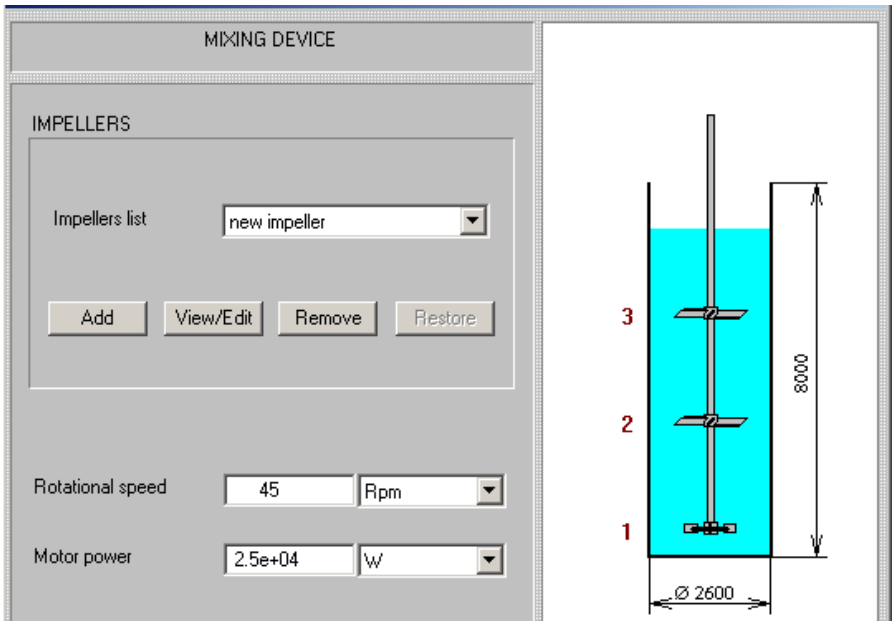


Figure 2.

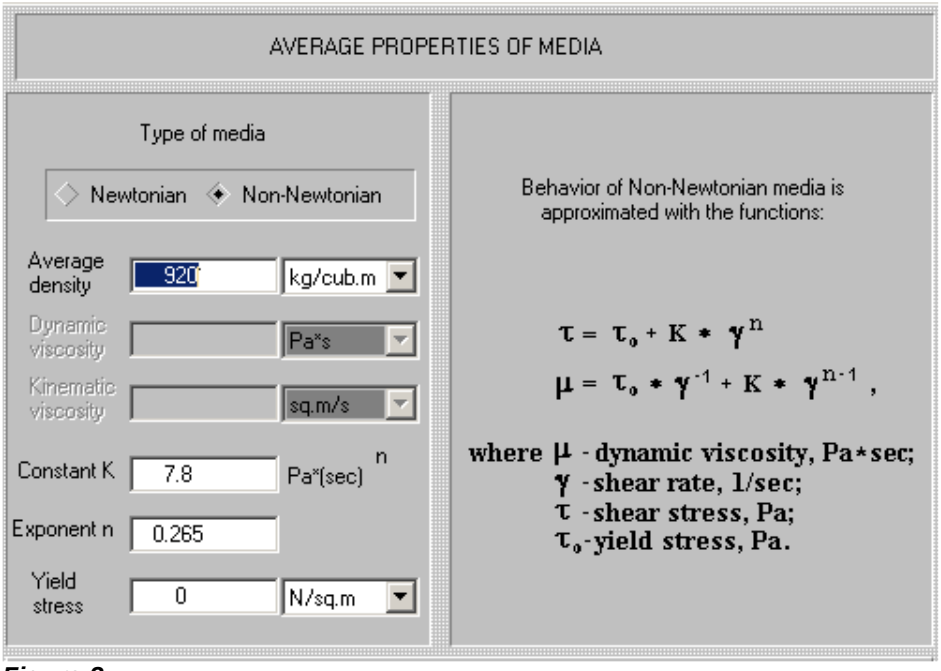
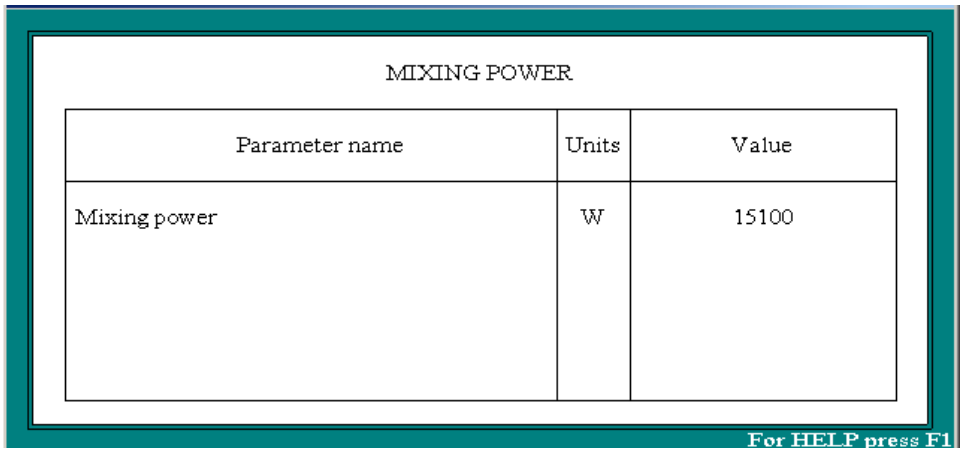


Figure 3.

2. Calculation of mixing parameters.

2.1. Hydrodynamics. Calculated power value is presented in the Figure 4.



MIXING POWER

Parameter name	Units	Value
Mixing power	W	15100

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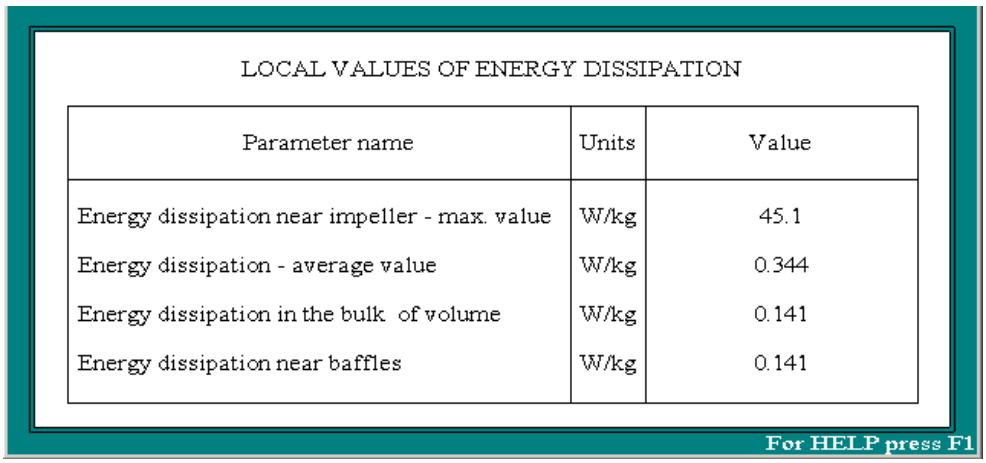
Figure 4.

2.2. Local Shear rates and Effective viscosity of media. Calculation is performed via Calculate>Turbulence>Characteristics for all impellers. Results of calculations are shown in the Figures 5-7.



LOCAL VALUES OF ENERGY DISSIPATION

Parameter name	Units	Value
Energy dissipation near impeller - max. value	W/kg	45.1
Energy dissipation - average value	W/kg	0.344
Energy dissipation in the bulk of volume	W/kg	0.141
Energy dissipation near baffles	W/kg	0.141

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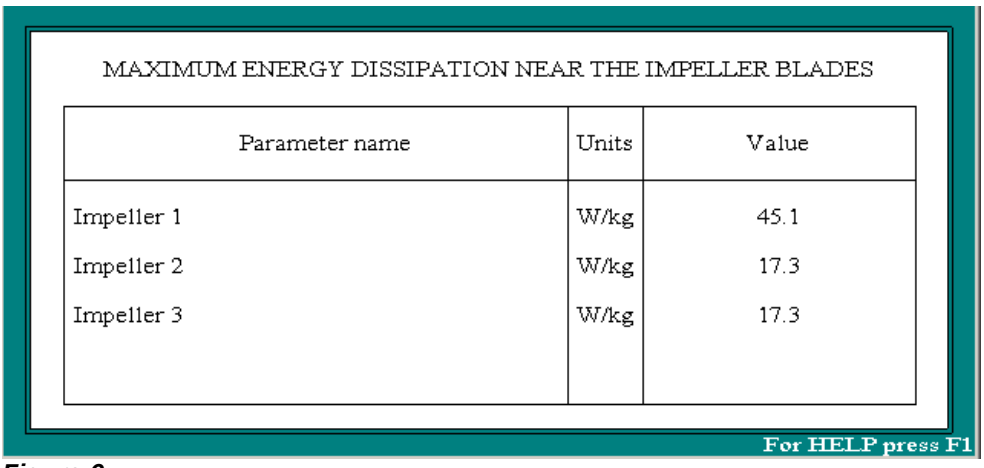
Figure 5.



MAXIMUM ENERGY DISSIPATION NEAR THE IMPELLER BLADES

Parameter name	Units	Value
Impeller 1	W/kg	45.1
Impeller 2	W/kg	17.3
Impeller 3	W/kg	17.3

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Figure 6.

EFFECTIVE VISCOSITY

Parameter name	Units	Value
Impeller 1	Pa*s	0.0500
Impeller 2	Pa*s	0.0871
Impeller 3	Pa*s	0.0871

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Figure 7.

LOCAL VALUES OF EFFECTIVE VISCOSITY

Parameter name	Units	Value
Effective viscosity in the bulk of volume	Pa*s	1.43
Effective viscosity in zone near baffles	Pa*s	1.43
Effective viscosity in zone of impeller with maximum dissipation	Pa*s	0.0500

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Figure 8.

2.3. Mechanical calculation of a console shaft. Initial data for calculation of console shaft are presented below in Figures 9 and 10.
Results of calculation are shown in the Figures 11 and 12.

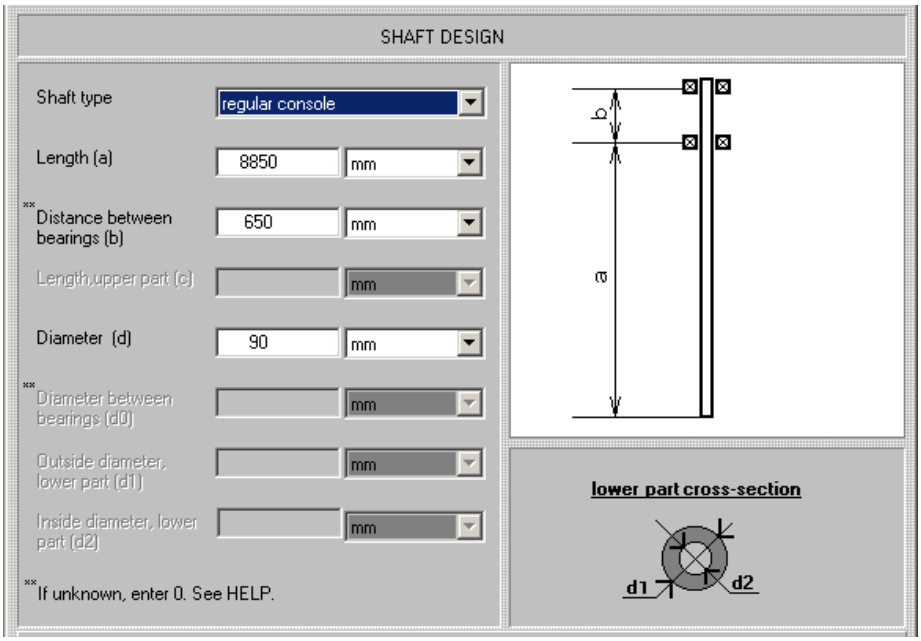

Figure 9.

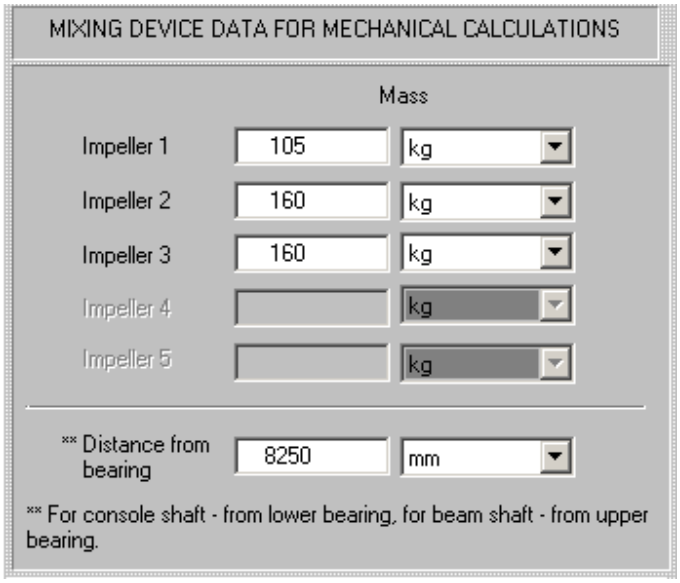

Figure 10.

TORSION SHEAR

Parameter name	Units	Value
Allowable shear stress	N/sq.m	1.5e+08
Max. shear stress in upper section of the shaft	N/sq.m	9.27e+07
Max. shear stress in lower section of the shaft	N/sq.m	9.27e+07
Max. shear stress in the shaft section between bearings	N/sq.m	9.27e+07

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Figure 11.

SHAFT VIBRATION CHARACTERISTICS

Parameter name	Units	Value
Critical frequency	1/s	0.523
Rotational frequency	Rps	0.750
Rotational to critical frequency ratio		1.43

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Figure 12.

2.4. Mechanical calculation of beam shaft. Initial data for calculation of a combined shaft with bottom bearing are presented below in Figure 13.
Results of calculation are shown in the Figures 14 and 15.

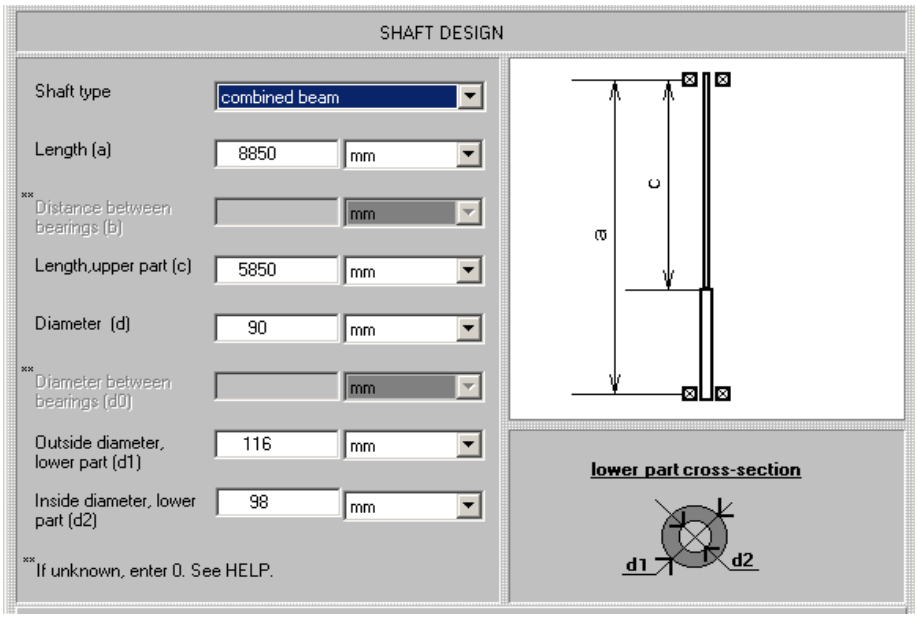

Figure 13.

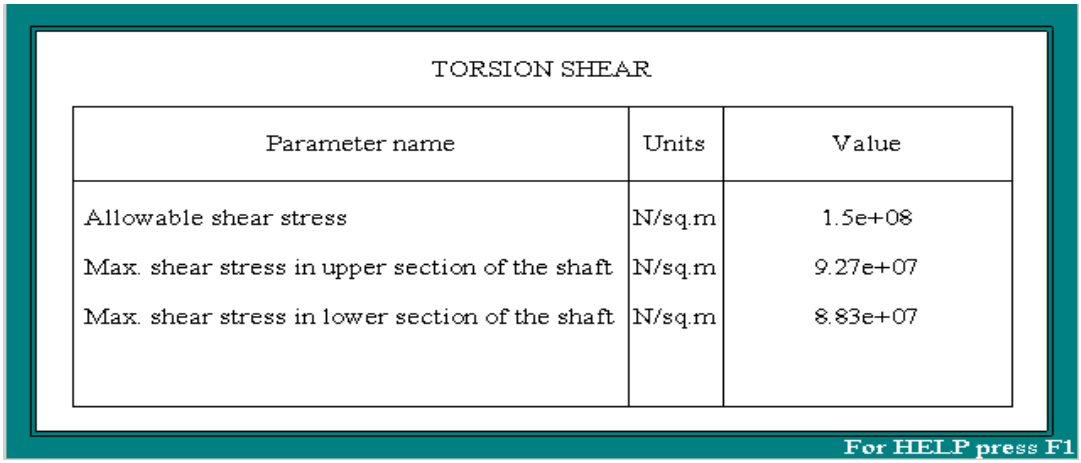

Figure 14.

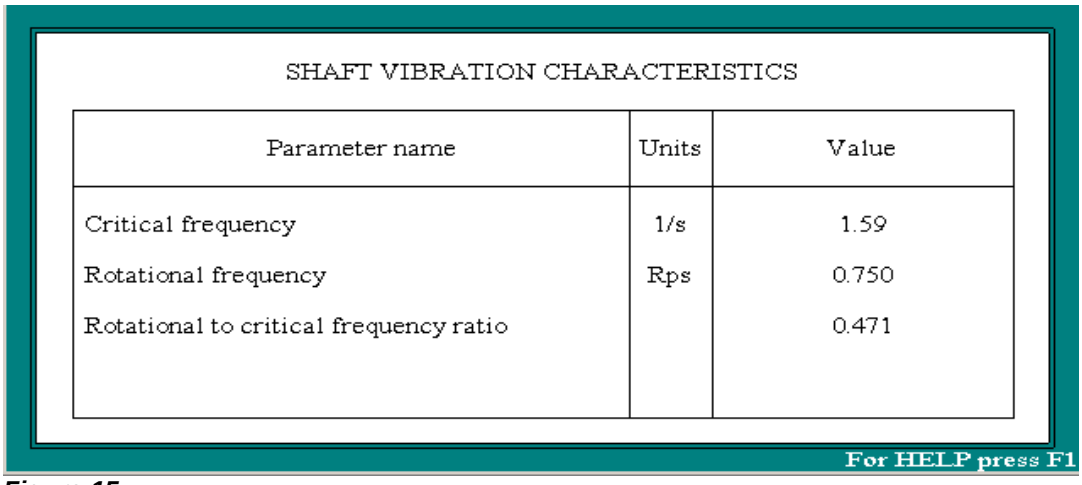

Figure 15.