VisiMix Turbulent Scaling Up/Down
User's Guide and Application Example

1. Introduction

Use this option to perform for ***scaling up / down*** procedure using modelling possibilities of the VisiMix Turbulent program.
Purpose of operation: transfer of a technological process from a prototype mixing tank to a geometrically similar target mixing tank of different size.

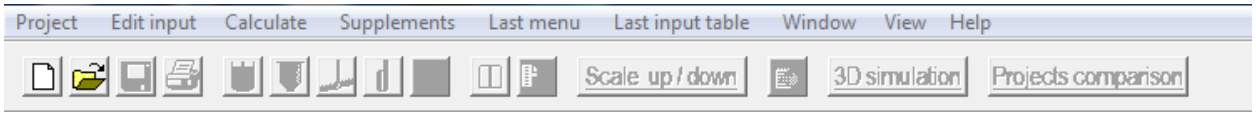
Initial data for scaling up / down:

- VisiMix project corresponding to the basic mixing tank (laboratory, pilot, or production) serving as a prototype
- Size of the target (scaled) mixing tank
- Scaling parameter – one of mixing or process-related parameters, defined by VisiMix, which is selected by user as a key scaling parameter that value must be the same in the prototype and target tanks

Key process characteristic in this program is understood as an important parameter of the process that is dependent on mixing and can be changed by change of mixing intensity (as, for example, size of droplets or suspending of solid particles). For a short description of connection between some mixing and process parameters – press Explanations button in the lower right part of screen.

2. User's Guide and Application Example

Open VisiMix Turbulent Scaling Up/Down program and the main VisiMix menu appears on the screen. It has the following structure:



Step 1. Start VisiMix Scaling Procedure

Open the project corresponding to the prototype-mixing tank. Drawing of the tank and opened window of initial data explorer are shown on the fig.1.

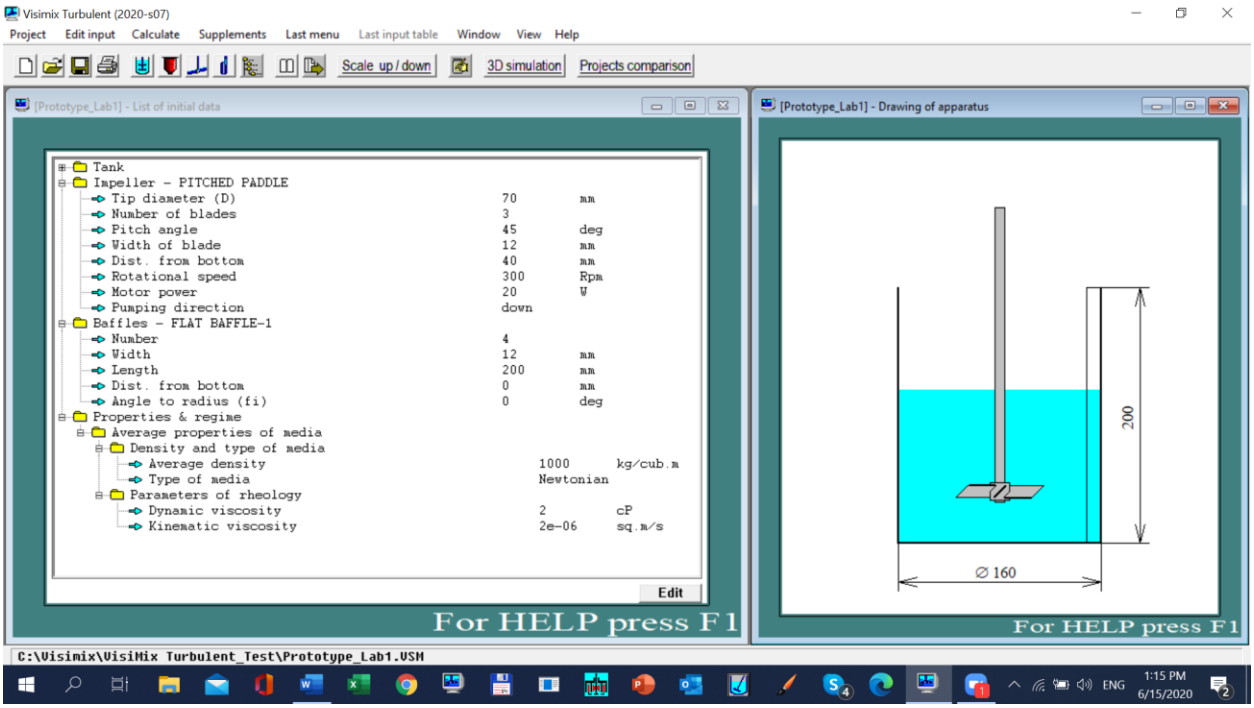


Figure 1. Prototype project. Tank drawing and initial data explorer.

Click ***Scale Up/Down*** under **Project** tab or the ***Scale Up/Down*** quick start button in the Command line on the upper part of VisiMix screen.

The SCALE UP/DOWN dialog is displayed, see fig.2.

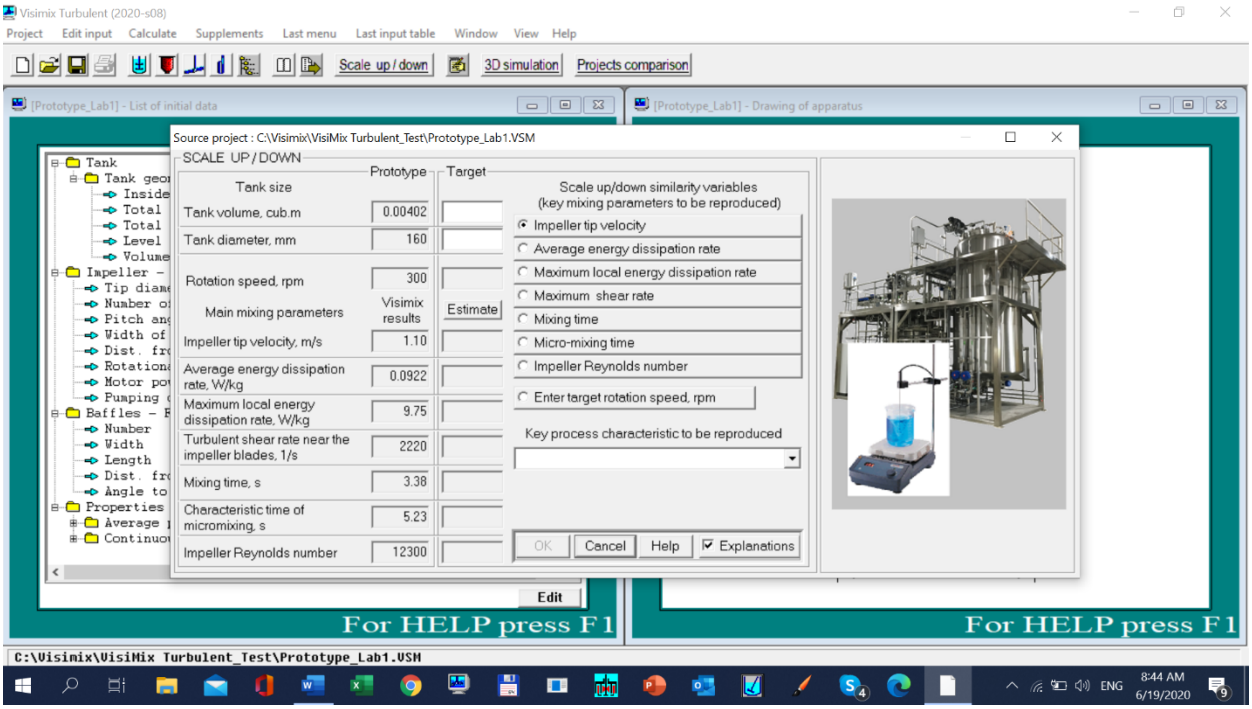


Figure 2. SCALE UP/DOWN dialog.

Main dimensions and values of main mixing parameters of prototype are shown in the PROTOTYPE column.

Enter diameter or volume of the ***Target*** tank.

STEP 2. Defining the scaling parameter - key mixing parameter that must be the same in the prototype and target.

The scaling parameter - key parameter that must be the same in the prototype and target – must be selected from the list of *key mixing parameters or from the list of key process characteristics****.** List of accessible key mixing parameters to be reproduced is presented in the right section of the window. Key process characteristic is chosen from the selection box below.

There is a strict connection between each process characteristic and one of the key mixing parameters, so the program automatically defines the mixing parameter corresponding to the selected key mixing characteristic. To learn more about this connection, click button Explanations.

Click button ***Estimate*** or radio button corresponding selected key mixing parameter.

After the key scaling parameter is selected, rotation speed of impeller and expected values of main mixing parameters of the target tank are defined by VisiMix and arrive in the right column of the left section of the window, see fig.3.

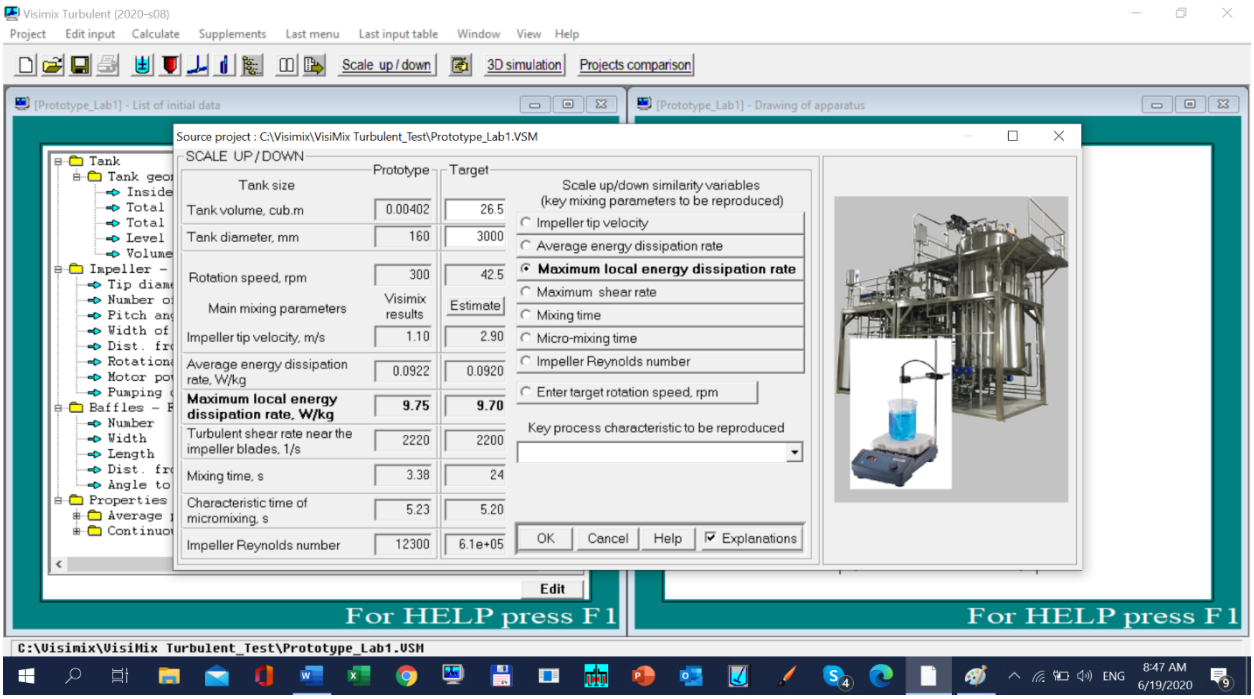


Figure 3. Selection of key mixing parameter to be reproduced and estimated values of target project main mixing parameters

Key process characteristic to be reproduced may be selected from the selection box below. The program automatically adjusting selection of key mixing parameter by selection of the key mixing parameter governing selected process characteristic, see fig.4.

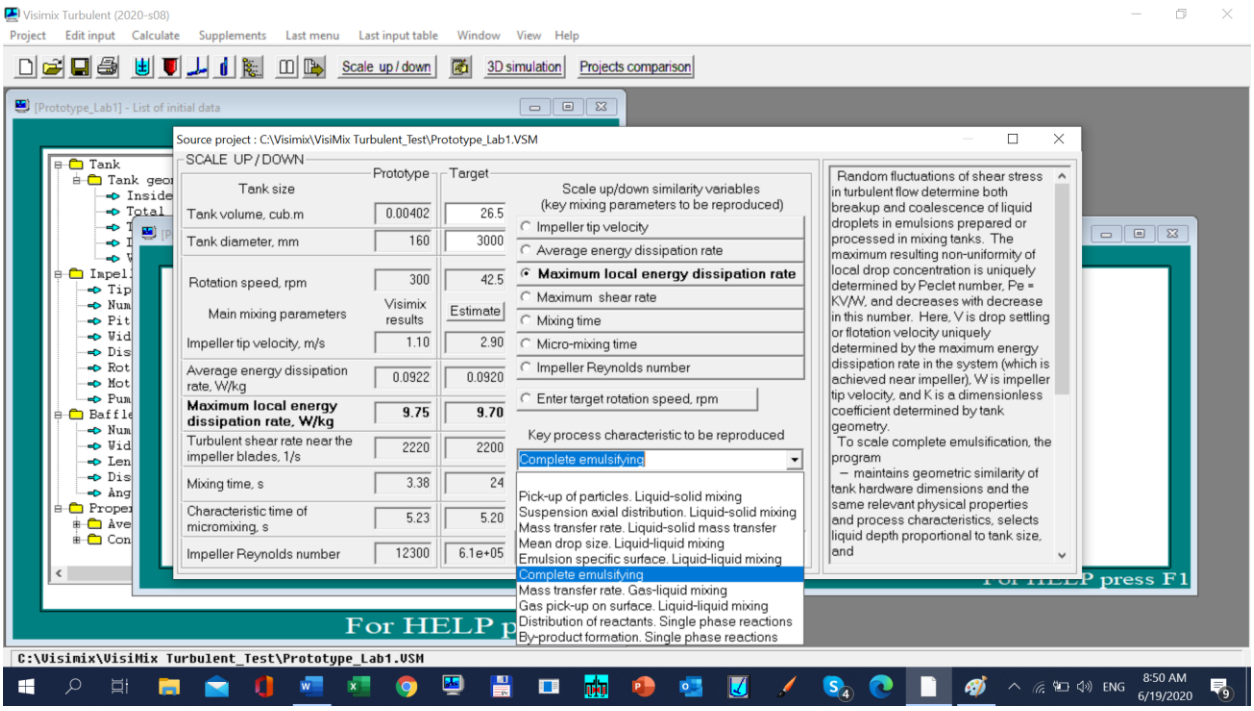


Figure 4. Selection of key process characteristic and governing mixing parameter to be reproduced.

User can define rotational speed of impeller in the target tank independently, as alternative to selection of scaling parameters. To do it, click option radio button corresponding to the line ***Enter target rotation speed, rpm*** and enter the rotation speed value, see fig. 5.

Press button ***Estimate.*** Expected values of main mixing parameters of the target tank arrive in the right column of the left section of the window.

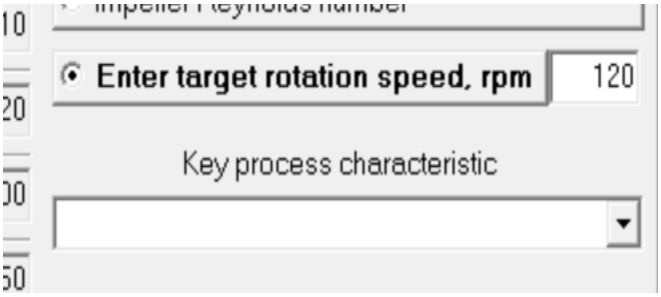


Figure 5. Entering rotation speed value.

Step 3. Creation of the target (scaled) VisiMix project

Click OK. VisiMix creates a project of the target mixing tank.

Enter name for the created project and ***Save it***, see fig. 6.

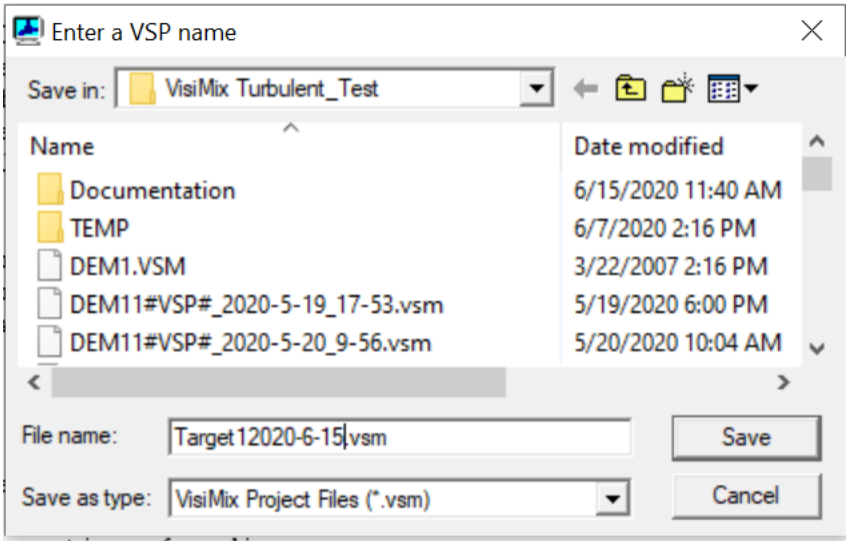


Figure 6. Creation of the target project.

VisiMix activates the target project and drawing of the target mixing tank appears on the ViSiMix screen, see fig. 7.

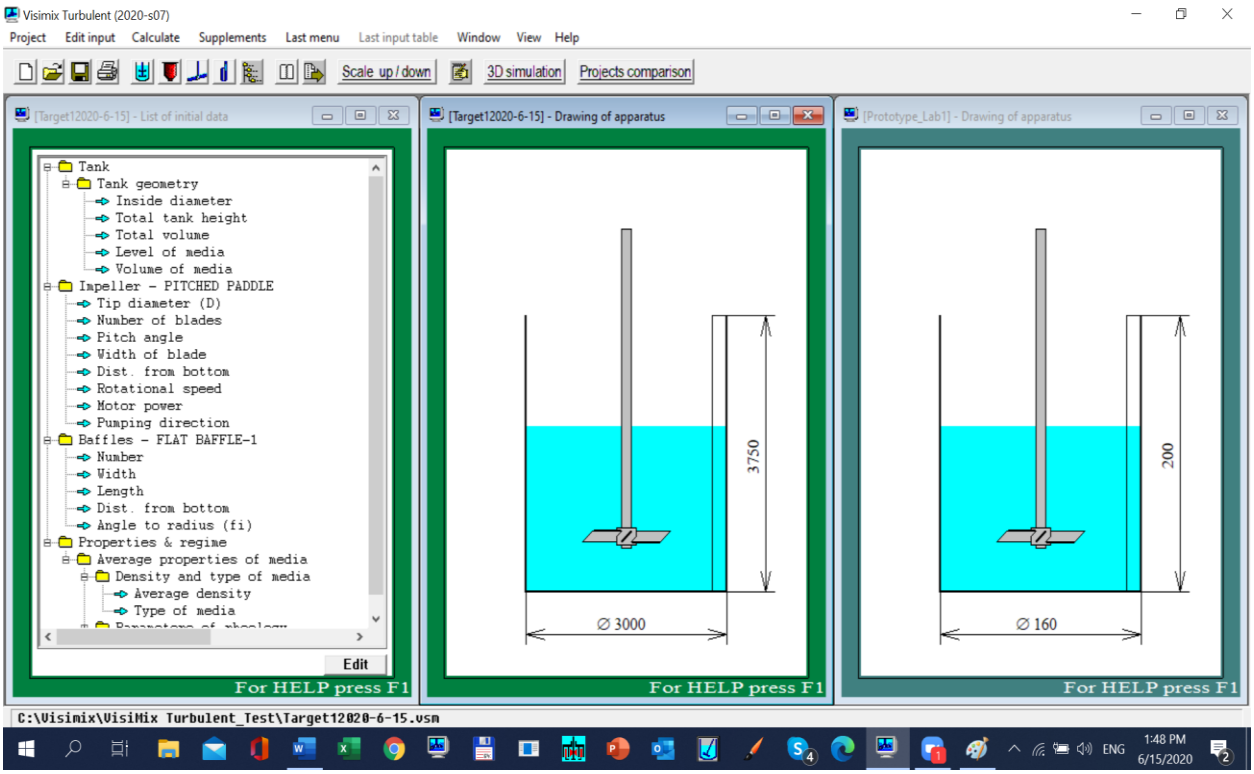


Figure 7. Both prototype and target projects are opened in Visimix.

The created project corresponds to the following conditions:

- Exact geometrical similarity of the tank bodies, impellers and all internal design elements of the target and prototype tanks.
- Complete identity of physical properties of media and process and regime parameters of the target and prototype projects.
- Identical or close values of the selected key scaling parameters of the target and prototype.

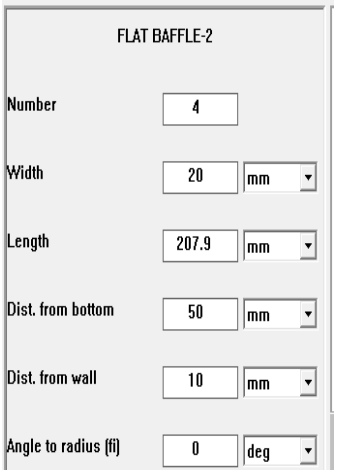
3. EXAMPLE

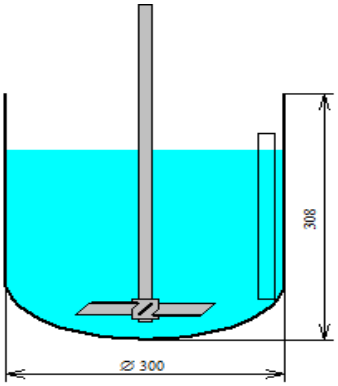
This example is a Liquid-solid process in which experience has shown that the best results are obtained in the following prototype when complete solid suspension of the solids is expected.

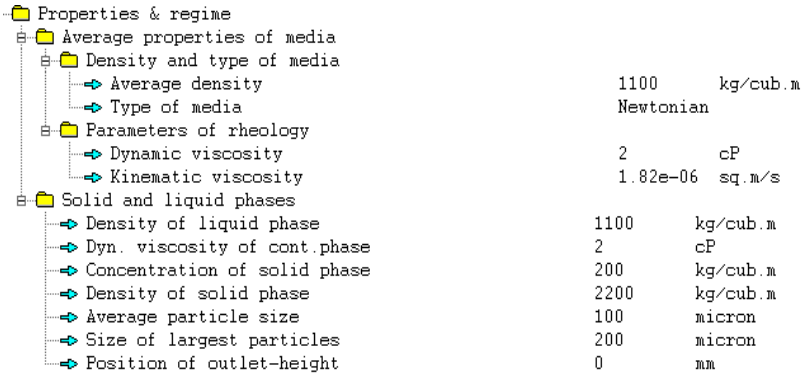
Input data for the prototype

TANK WITH ELLIPTICAL BOTTOM		
Inside diameter	300	mm
Total tank height	308	mm
Total volume	20	l
Level of media	237.2	mm
Volume of media	15	l

PITCHED PADDLE		
Tip diameter (D)	150	mm
Number of blades	4	
Pitch angle	45	deg
Width of blade	20	mm
Dist. from bottom	38	mm
Rotational speed	200	Rpm
Motor power	1	KW
Pumping direction	down	



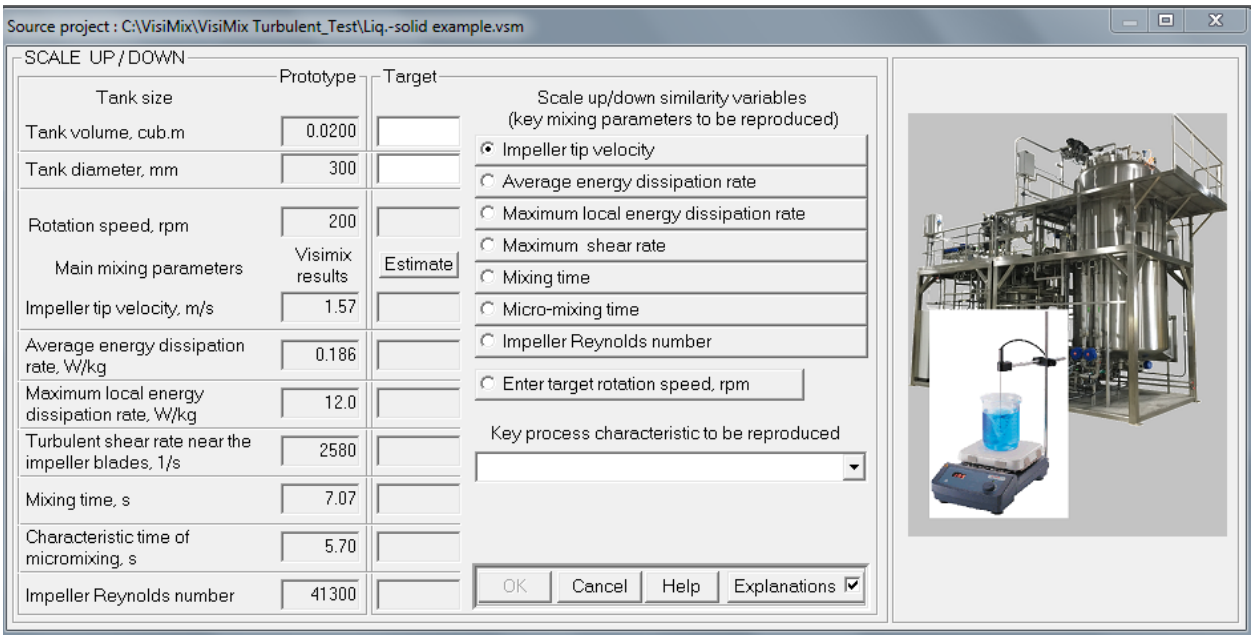




Purpose of operation: transfer of a technological process from a 20 L prototype mixing tank to a geometrically similar 2000 mixing tank.

Following the above mentioned indications:

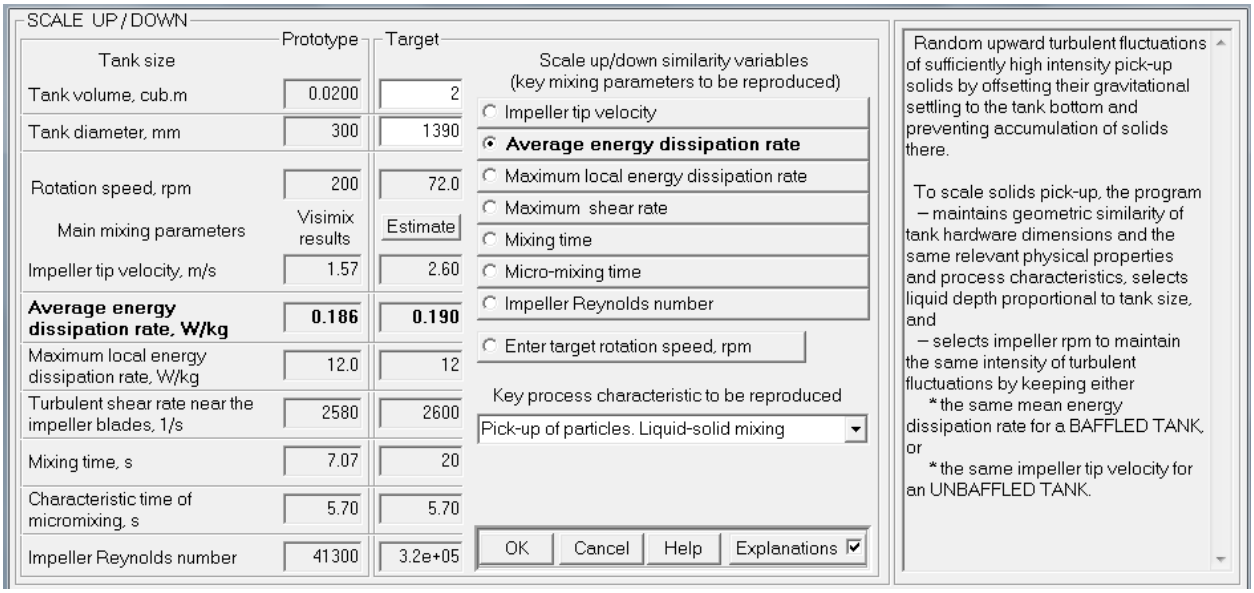
Open the project corresponding to the prototype-mixing tank.- Click ***Scale Up/Down***



In Target column:

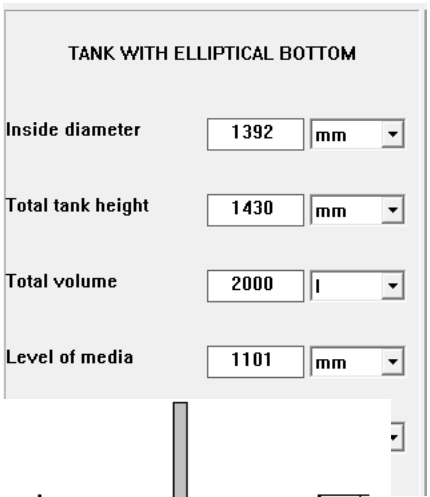
Tank Volume = 2 m3 (2000 L)

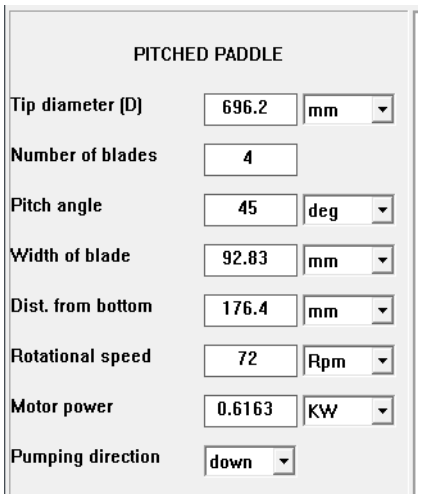
Key process characteristic to be reproduced: Pick–up of particles liquid-solid mixing and following information appear:

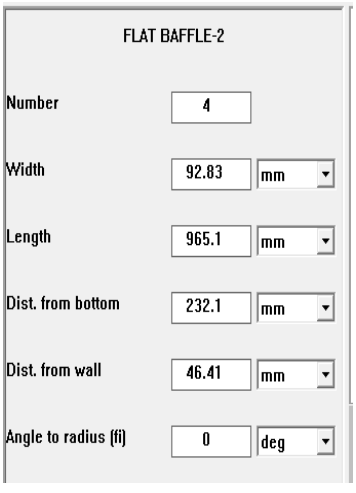


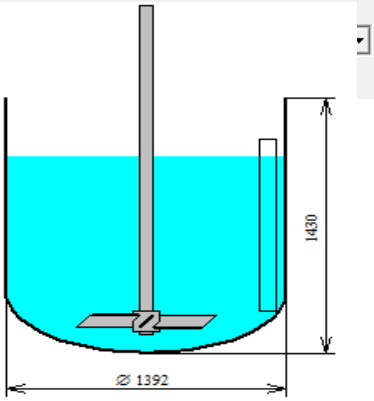
In target column estimated values of target project main mixing parameters, in **bold** key mixing parameter related with Key process characteristic selected. On the right, an explanation about selected key process characteristic.

Click OK. VisiMix creates a project of the target-mixing tank. Enter name for the created project and ***Save it as usual in VisiMix Turbulent.*** VisiMix activates the target project and the reactor 2000 L is as follow:







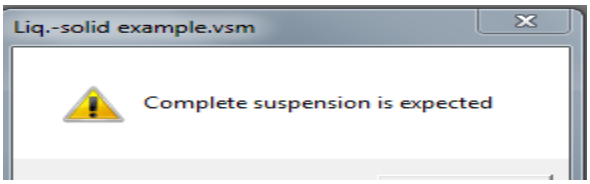


Same properties as in prototype

Properties & regime		
Average properties of media		
Density and type of media		
Average density	1100	kg/cub.m
Type of media	Newtonian	
Parameters of rheology		
Dynamic viscosity	2	cP
Kinematic viscosity	1.82e-06	sq.m/s
Solid and liquid phases		
Density of liquid phase	1100	kg/cub.m
Dyn. viscosity of cont.phase	2	cP
Concentration of solid phase	200	kg/cub.m
Density of solid phase	2200	kg/cub.m
Average particle size	100	micron
Size of largest particles	200	micron
Position of outlet-height	0	mm

Comparison of the result desired

Prototype (10 L Reactor)



Scaled up Reactor (2000 L Reactor)