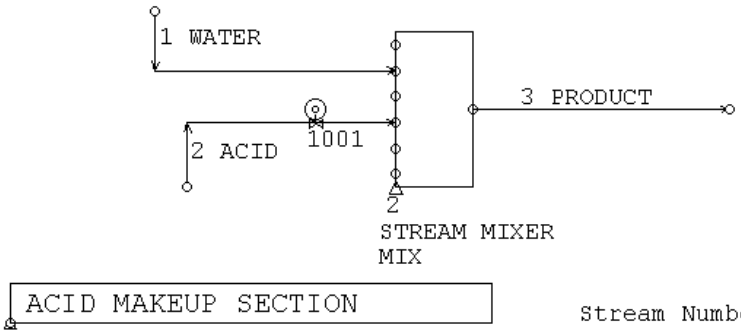
Mass Balance
Example 1



PROBLEM DESCRIPTION

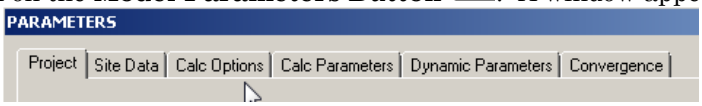
This example will be used to illustrate the mass balance capabilities of **METSIM**.

Water and Acid will be added to a Mixer so that a specified concentration of Acid will be achieved in the product, stream 3.

A Feedback control will be used to adjust the flowrate of Acid entering the Mixer in stream 2 to achieve the desired concentration of **65 GPL of Acid in the product**, stream 3.

Problem Solution

1. Click on the **Model Parameters Button**  . A window appears with a number of clickable tabs.



A. The window opens on the **Project** Entry window. From here a Title and a Case Identifier and other Project information may be entered.

B. Click on the **Calc Options Tab** and check the box next to Mass Balance.

C. Click on the **Calc Parameters Tab** and set the units of Mass and Time to **KG/Hr.**

2. Click on the **COMP Menu** and then "DBAS Component Database".

A. A window appears displaying a table of the elements. Select H, O and S and a list of all the components in the database composed of these elements will be called up. Select the aqueous **H2SO4**.

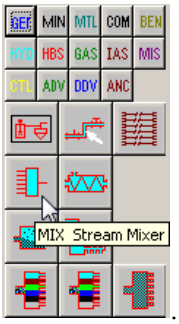
Components:

No.	Name	Formula	Phase Type
1	Water	H2O	aqueous
2	Acid	H2SO4	aqueous

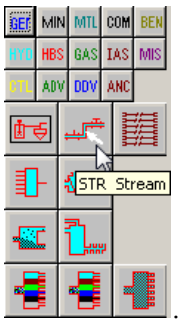
IMPORTANT NOTE: Concerning Sorting Components.
Refer to **NOTE 1** on **Page 13.**

B. From the **Comp Menu** select "ICPL Insert Phase Labels on Component Names".

3. Click on the **Screen Object Button** "GEN"  and then select a Stream Mixer, MIX



Hold the Cursor over a Button for a Description of the object.



Streams are added using the "STR Stream" Button.

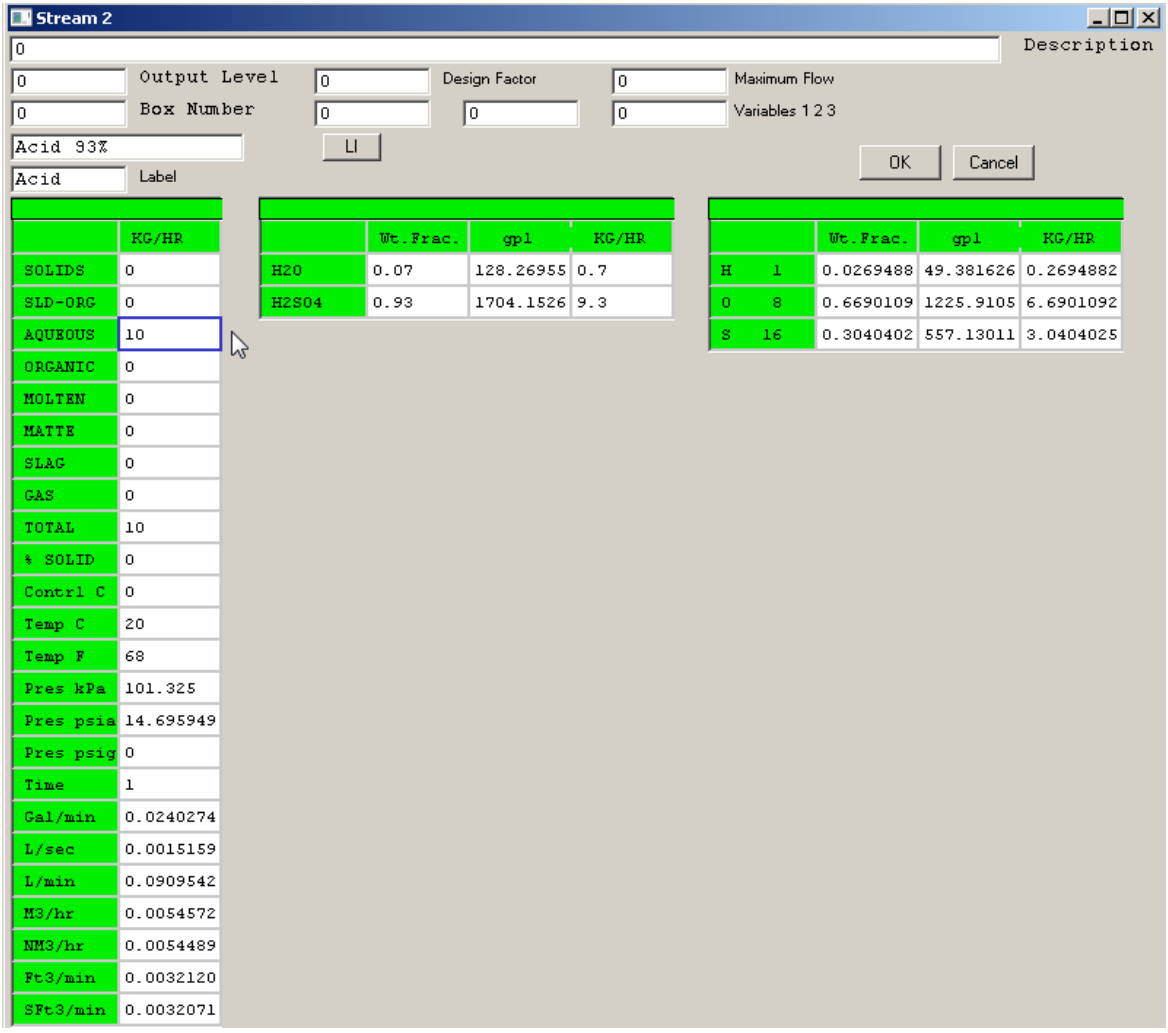
Streams 1 and 2 are entered as feed streams, and stream 3 as the product stream.

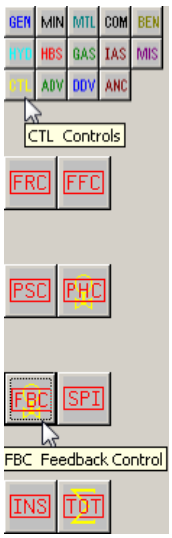
INPUT STREAM DATA may now be entered.

Stream 1 50 KG/Hr
Component Assays H2O1 ..... 1 (Meaning 100%)

Stream 2 10 KG/Hr
Component Assays H2O1 ..... 0.07
H2SO4 ..... 0.93

Click on the Stream Number with the "Edit Object Data" Tool to activate the Input Stream Data Screen. Enter Phase flowrates first then you can enter Component Assays.





PROCESS CONTROLS

The control strategy may now be entered. An FBC-Feedback Control may be entered which adjusts the flowrate of stream 2, Acid, until there is 65 GPL of acid in stream 3, the product. The Value Function to use is of the following form C VGPL S and can be read as (Component Number) Grams Per Liter in (Stream Number).

Where C is the component number of the Acid and S is the stream number where the GPL of the Acid is calculated. The value function would be entered as;

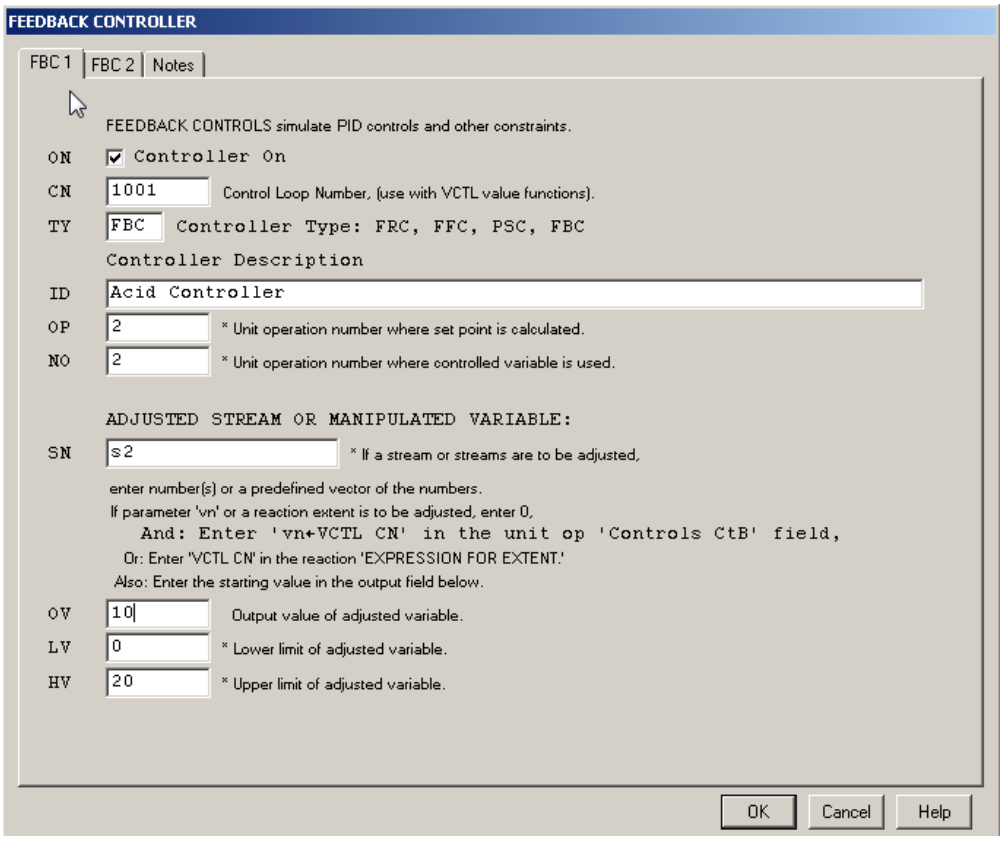
c2 VGPL s3

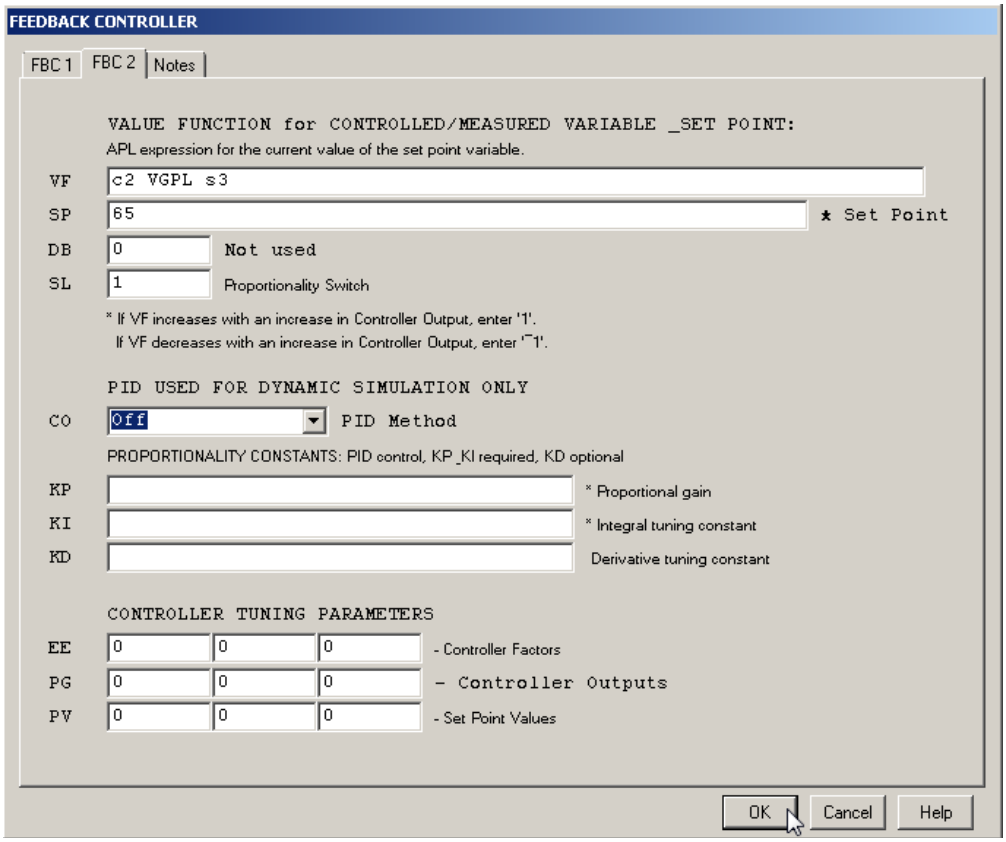
The small c in front of the component number in the Value Function above is used to update the component number if changes are made to the order of the components.

The small s before the stream number in the Value Function above is used to update the stream number if stream numbers are renumbered.

Feedback Controller Entry Screens

FBC1 Screen							**FBC2 Screen**		
ID	**CN**	**OP**	**NO**	**SN**	**LV**	**HV**	**VF**	**SP**	**SL**
Control Salt Content	1001	2	2	s2	0	1000	c3 VGPL s3	0.1	-1





Saving Model Files

Each flowsheet is saved in a single file containing all data, graphics etc. All models are saved as internal format APL component files, (filename.SFW). After a model is loaded, all data becomes immediately available.

It is important therefore, to save the model regularly during development, and almost always prior to calculation.

After Calculating  the file the results may be viewed.

```
    Acid Tank - Stream Mixer
Mass & Heat Balance with FBC & DDE

    CASE DEFINITION

   Project Information:
      Owner    :
      Location :
      Title    : Acid Tank - Stream Mixer
      Case:Mass & Heat Balance with FBC & DDE
      Purpose  : Training Example 1
      Number   :
      Engineer :
      Logo File:
      Modeller :
      Revision : A

   Data Storage File Name    : Example1.sfw

   Mass Balance Option          : ON

   Units of Mass                : kilogram
   Units of Time                : hour
```

STREAM DATA

AQUEOUS - KG/HR

NO.	STREAM	H2O	H2SO4
1	Water Feed	50.0000	0.00000
2	Acid 93%	0.2525	3.35403
3	PRODUCT	50.2525	3.35403

AQUEOUS - WEIGHT PERCENT

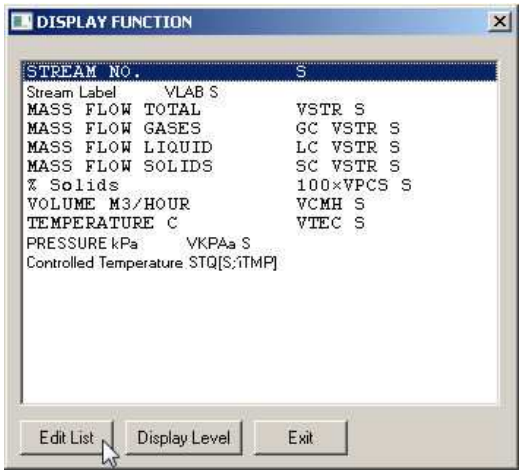
NO.	STREAM	H2O	H2SO4
1	Water Feed	100.000	0.0000
2	Acid 93%	7.000	93.0000
3	PRODUCT	93.743	6.2568

AQUEOUS - GRAMS PER LITER

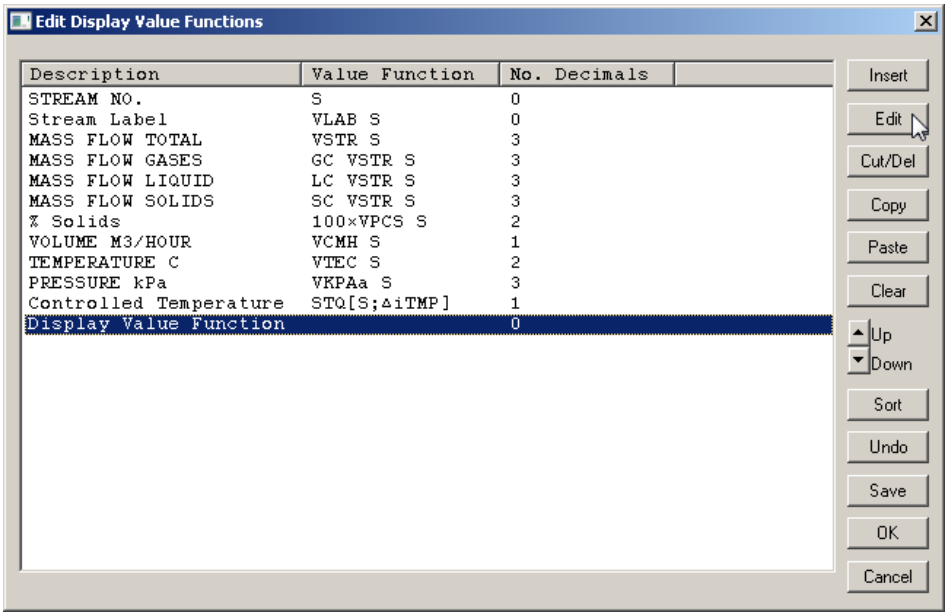
NO.	STREAM	H2O	H2SO4
1	Water Feed	998.259	0.00
2	Acid 93%	128.270	1704.15
3	PRODUCT	973.875	65.00

DISPLAY VALUE FUNCTIONS FOR STREAMS

Clicking on the Display Value Function For Streams Buttons calls up the following window.



Click on the EDIT LIST Button calls up the following window where you are able to create a new option.

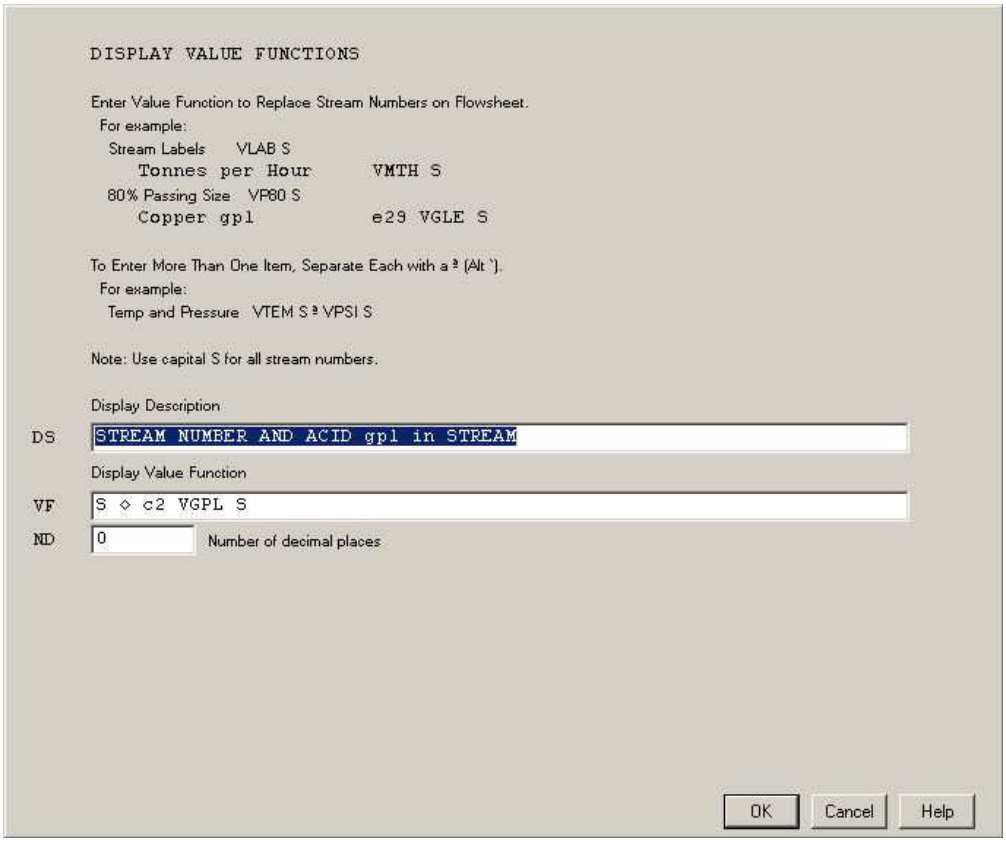


Highlight the "Display Value Function" Line in the list displayed and Click on the EDIT Button. This calls Up the following Window where you Enter a Description which will be displayed on the Palette and any Value Functions you want displayed on a stream.

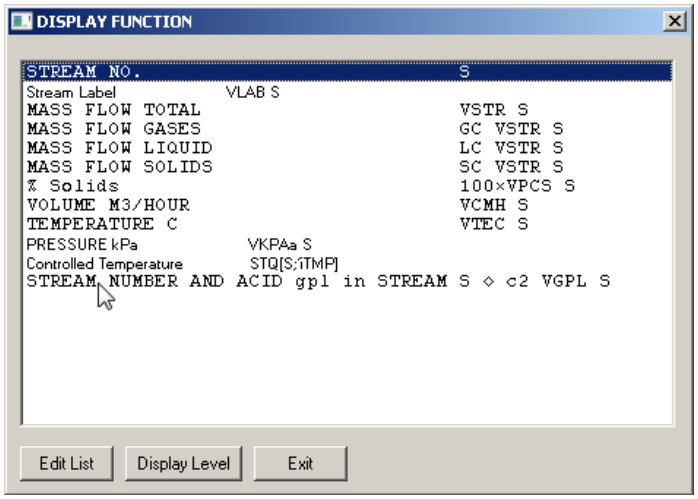
For "DS – Display Description" enter STREAM NUMBER AND ACID gpl in STREAM.
For "VF – Display Value Function" enter

S ◇ c2 VGPL S

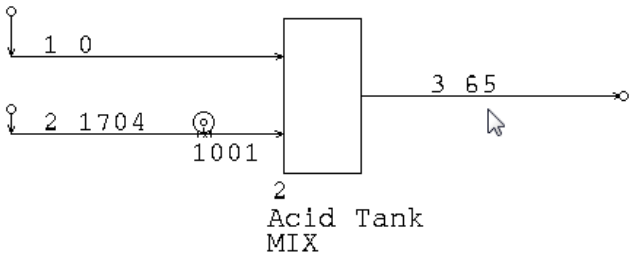
Where
S represents the Stream Number
◇ is the key combination which allows more than one statement on a line ALT ~
c2 VGPL S is grams per litter (gpl) of component two (H2SO4) in the Stream



Clicking OK when you are finished entering the Value Functions to be entered calls up the following window.



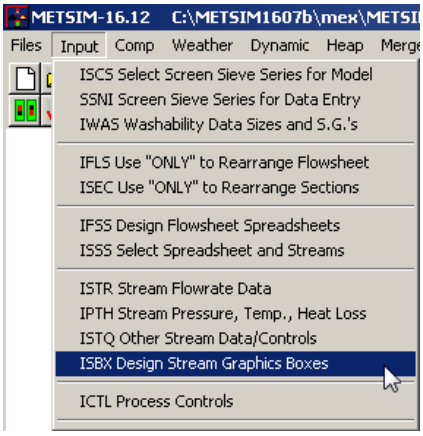
Click on the Display you just created to have it displayed on the streams.



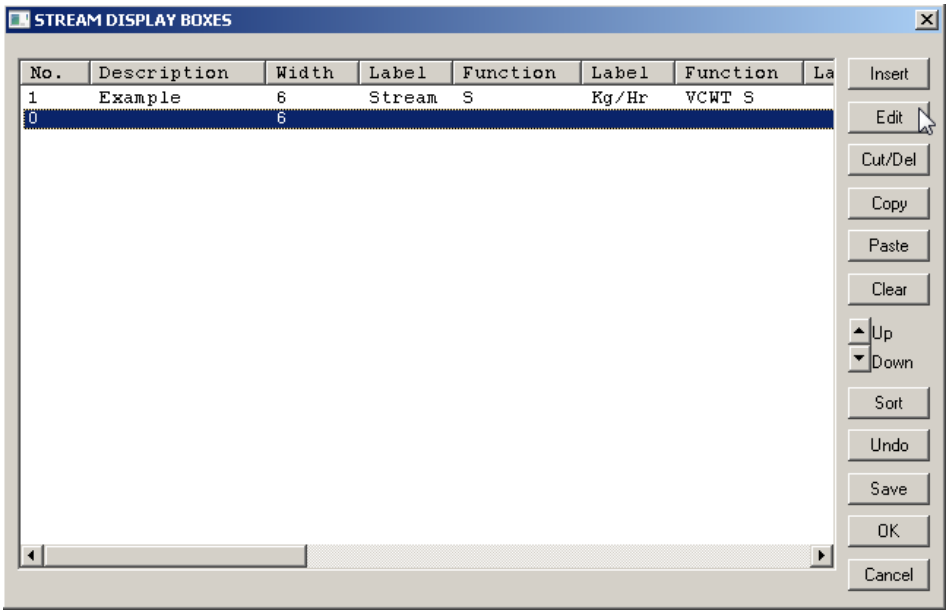
ACID MAKEUP SECTION STREAM NUMBER AND ACID gpl in STREAM

Design GRAPHIC STREAM BOXES

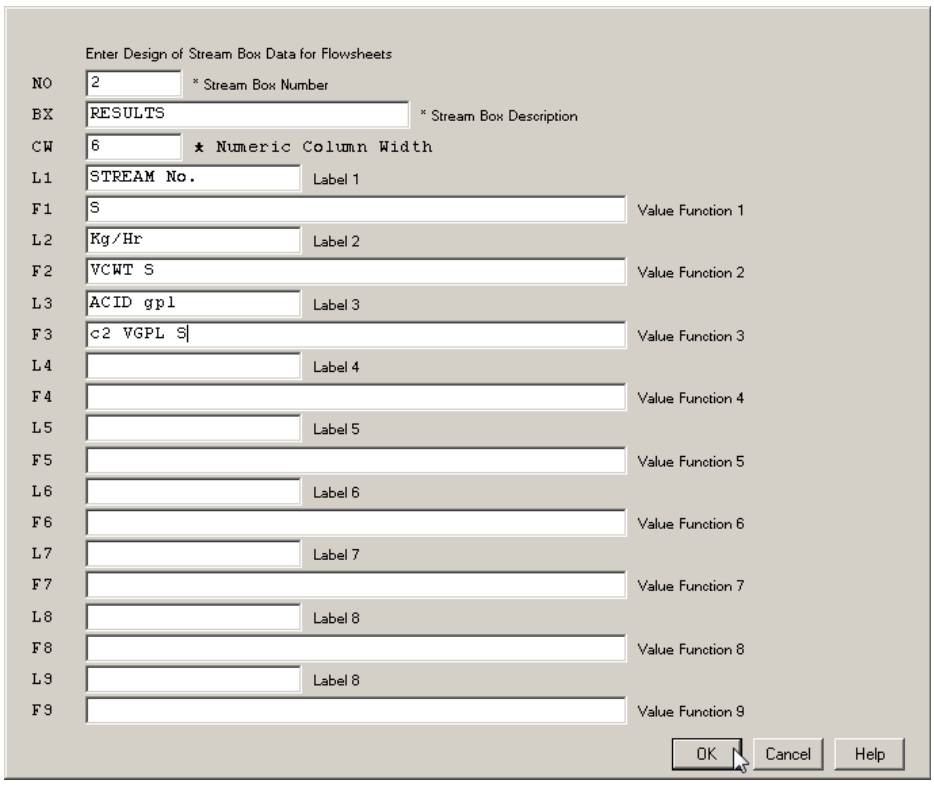
To design Graphic Screen Boxes select the "INPUT Menu" and then "ISBX Design Graphic Screen Boxes".



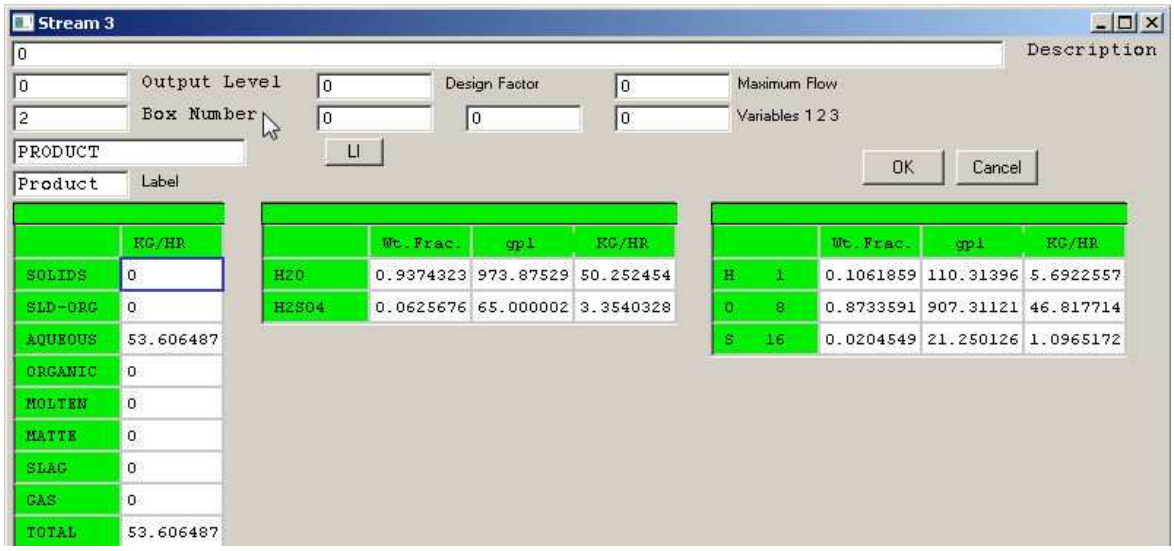
This will call up the following List Screen.



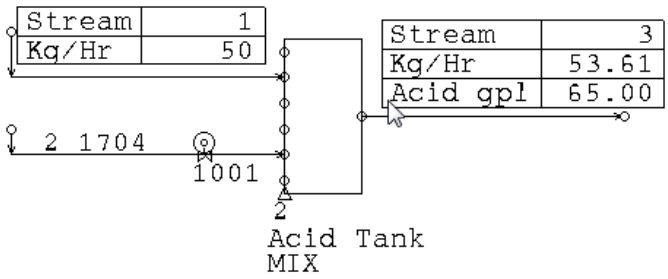
To add a new Graphic Screen Box highlight a blank line in the List Screen and Click the "Edit" Button. This will call up the following Entry Screen.



With the "EDIT OBJECT DATA" Tool  click on the stream where you want the Graphic Display Box to be displayed. The following window is activated.



Enter the Box Number of the Graphic Screen Box you wish to use in the "BOX NUMBER" field then click OK.

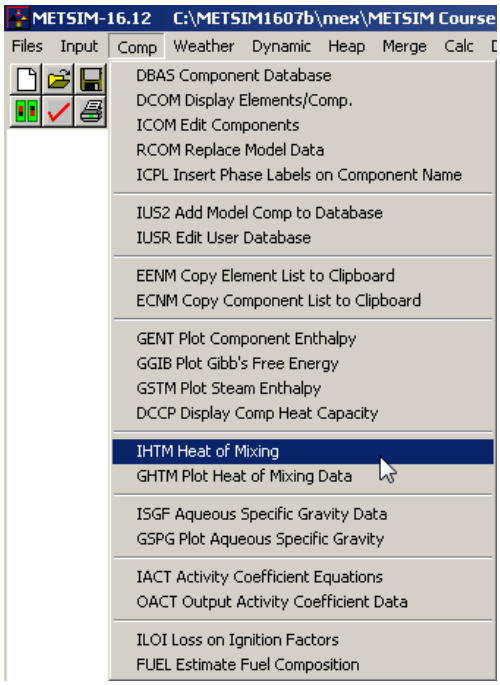


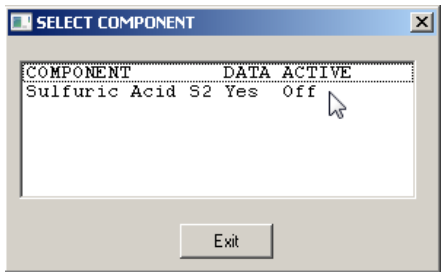
Turning on the Heat Balance Module and Heat Of Mixing.

A. Click on the **Model Parameters Button**  . A window appears with a number of clickable tabs.

B. Click on the **Calc Options Window** and check the box next to Heat Balance and Heat Of Mixing Switch. Click OK to close the Menu.

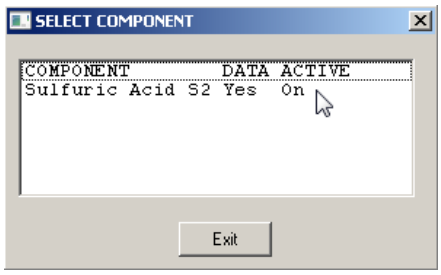
C. From the **COMP Menu** select **"ITHM Heat Of Mixing"**.



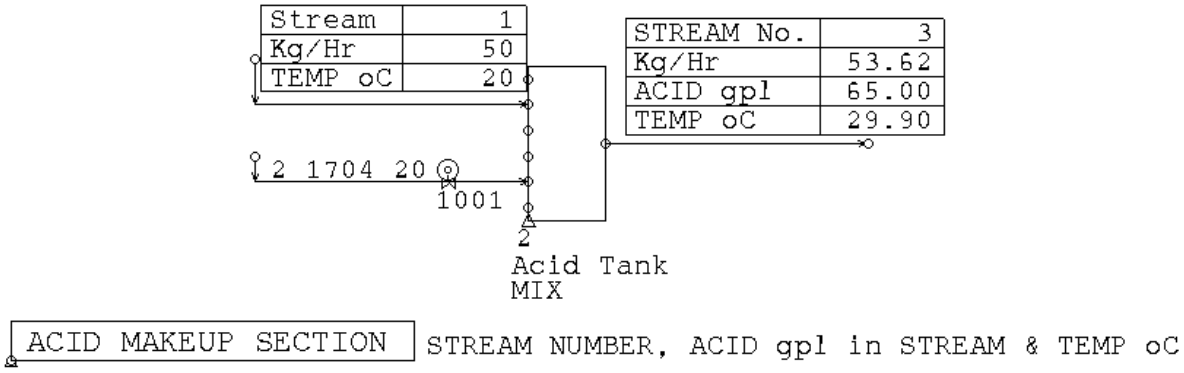


The window which is called up displays the Aqueous components and if they have "HTM-Heat Of Mixing Data" and if it is Activated. The above window shows Sulfuric Acid has HTM data but is not Activated.

To Activate the data click on the Sulfuric Acid in the List and a window displaying the HTM data for Sulfuric Acid is called up. Clicking OK Activates this data and returns you to the previous Window which now shows the Sulfuric Acid is Active.



SAVE the flowsheet then **CALCULATE** and view the results to see the temperatures in the streams.




```
     Acid Tank - Stream Mixer
Mass & Heat Balance with FBC & DDE

          STREAM DATA

   AQUEOUS - KG/HR
   NO. STREAM          H2O    H2SO4
   ---+----------+-------+-------
     1 Water Feed 50.0000 0.00000
     2 Acid 93%    0.2531 3.36284
     3 PRODUCT    50.2531 3.36284

   AQUEOUS - WEIGHT PERCENT
   NO. STREAM          H2O    H2SO4
   ---+----------+-------+-------
     1 Water Feed 100.000  0.0000
     2 Acid 93%     7.000 93.0000
     3 PRODUCT     93.728  6.2721

   AQUEOUS - GRAMS PER LITER
   NO. STREAM          H2O    H2SO4
   ---+----------+-------+-------
     1 Water Feed 998.259    0.00
     2 Acid 93%   128.270 1704.15
     3 PRODUCT    971.336   65.00

                  HEAT BALANCE SUMMARY - 1 KILOCALORIES/HOUR

                       INPUT    HEAT    HEAT  ENERGY    HEAT    HEAT  OUTPUT
    OP PROCESS STEP   STREAM   REACT   SOLUT   INPUT    LOSS   REQRD  STREAM   TOTAL
   ---+---------------+-------+-------+-------+-------+-------+-------+-------+-------+
     1 ACID MAKEUP SECT       0       0       0       0       0       0       0       0
     2 Acid Tank           -257       0     508       0       0       0    -251       0

                    HEAT OF REACTION - 1000 KILOCALORIES/HOUR

    NO PROCESS STEP    ------TOTAL-----/MOLE---REACTION-----------------------

                          STREAM TEMPERATURES AND ENTHALPIES

   NO. STREAM      TEMP-C  TEMP-F   KCAL/HR    BTU/HR     KJ/HR
   ---+----------+-------+-------+---------+---------+---------
     1 Water Feed 20.0000 68.0000-250.00000-991.00000-1044.0000
     2 Acid 93%   20.0000 68.0000  -7.00000 -27.00000  -29.0000
     3 PRODUCT    29.9004 85.8207 251.00000 997.00000 1052.000
```