

分离过程模型分类

- 简单分离单元模型

Separators

- 塔设备单元模型

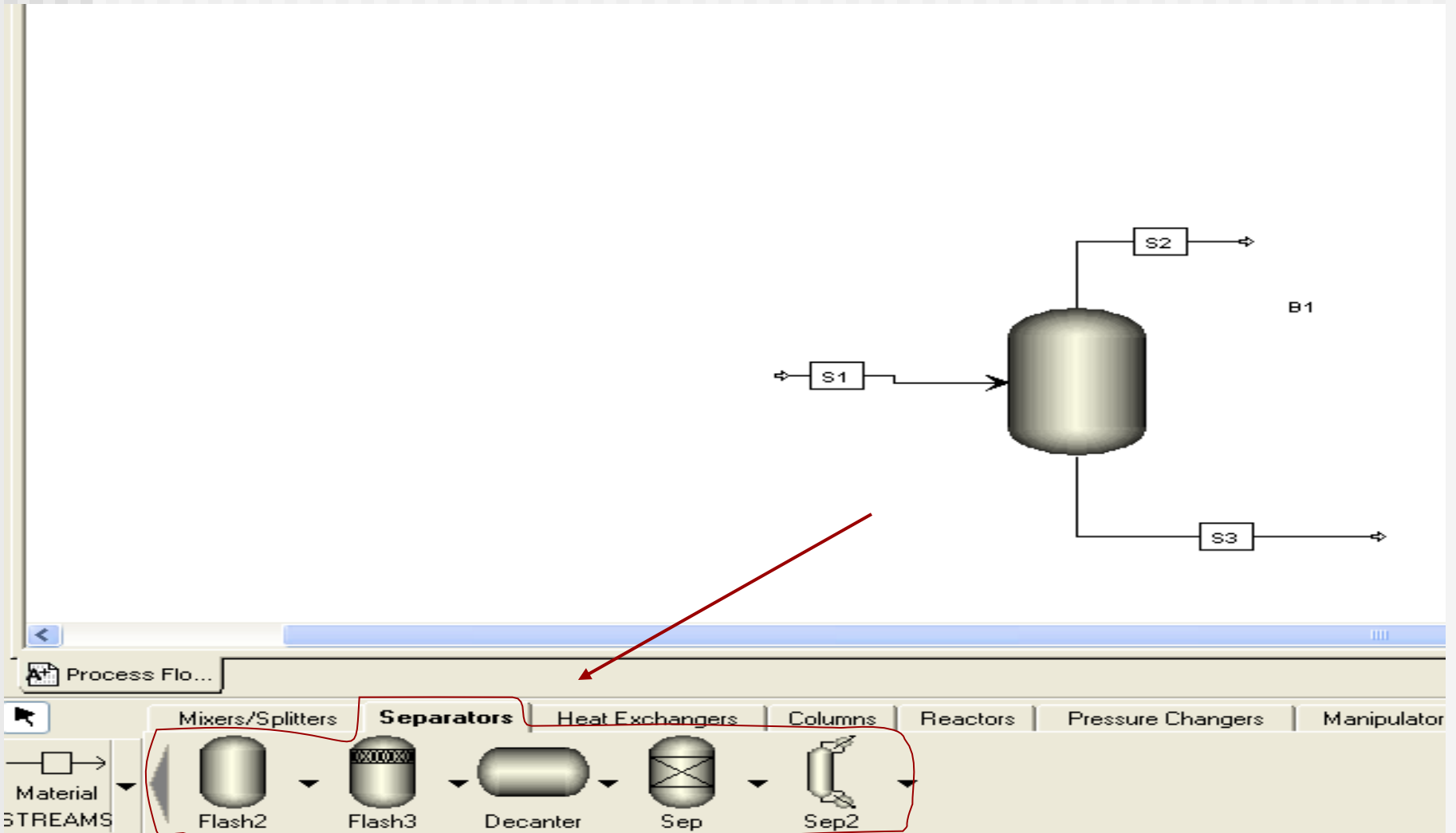
Columns

简单分离单元模型

简单分离单元模型包含五个模块：

- 1 两相闪蒸器 (Flash2)
- 2 三相闪蒸器 (Flash3)
- 3 倾析器 (Decanter)
- 4 组分分离器 (Sep)
- 5 两出口组分分离器 (Sep2)

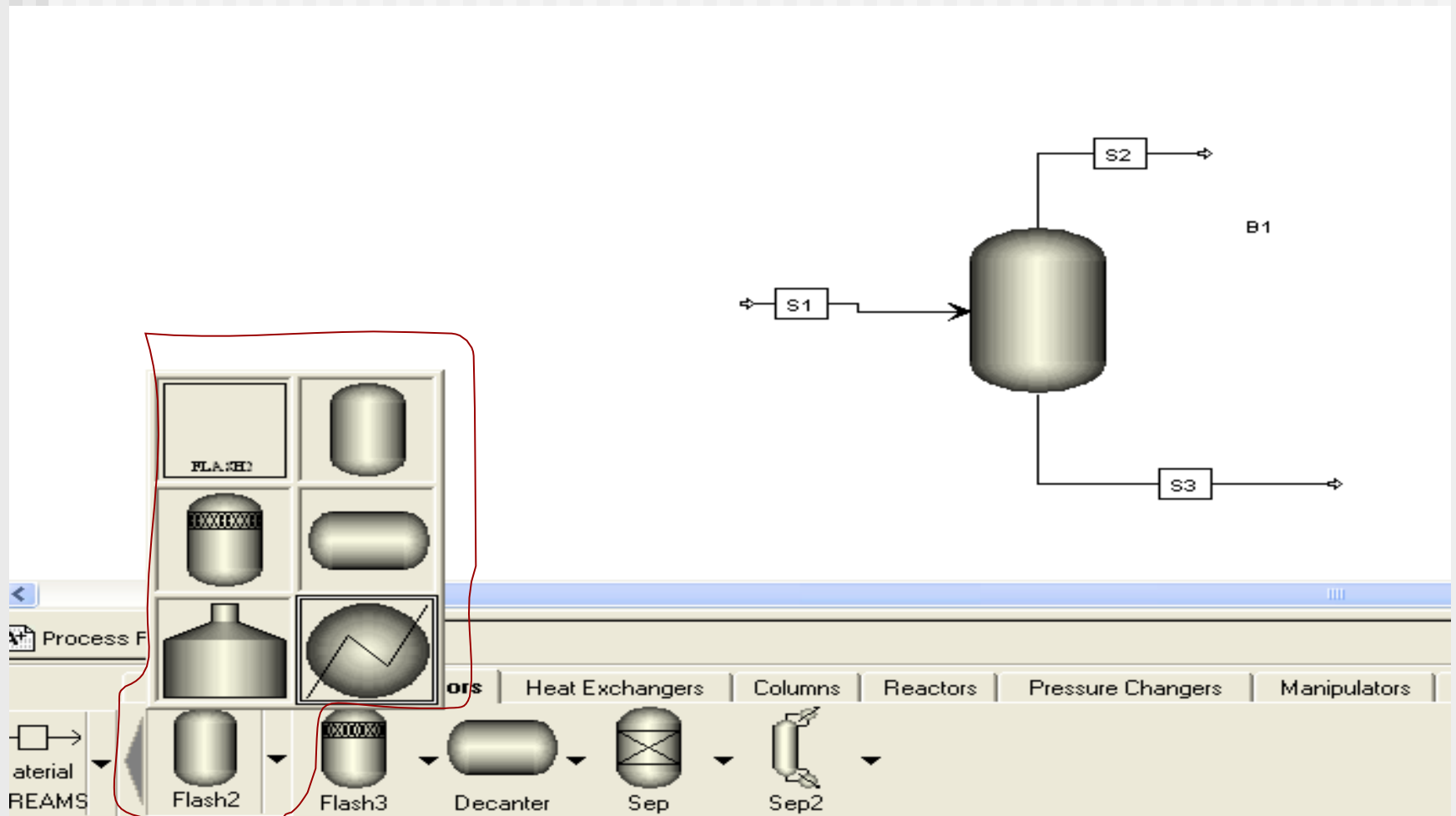
简单分离单元模型



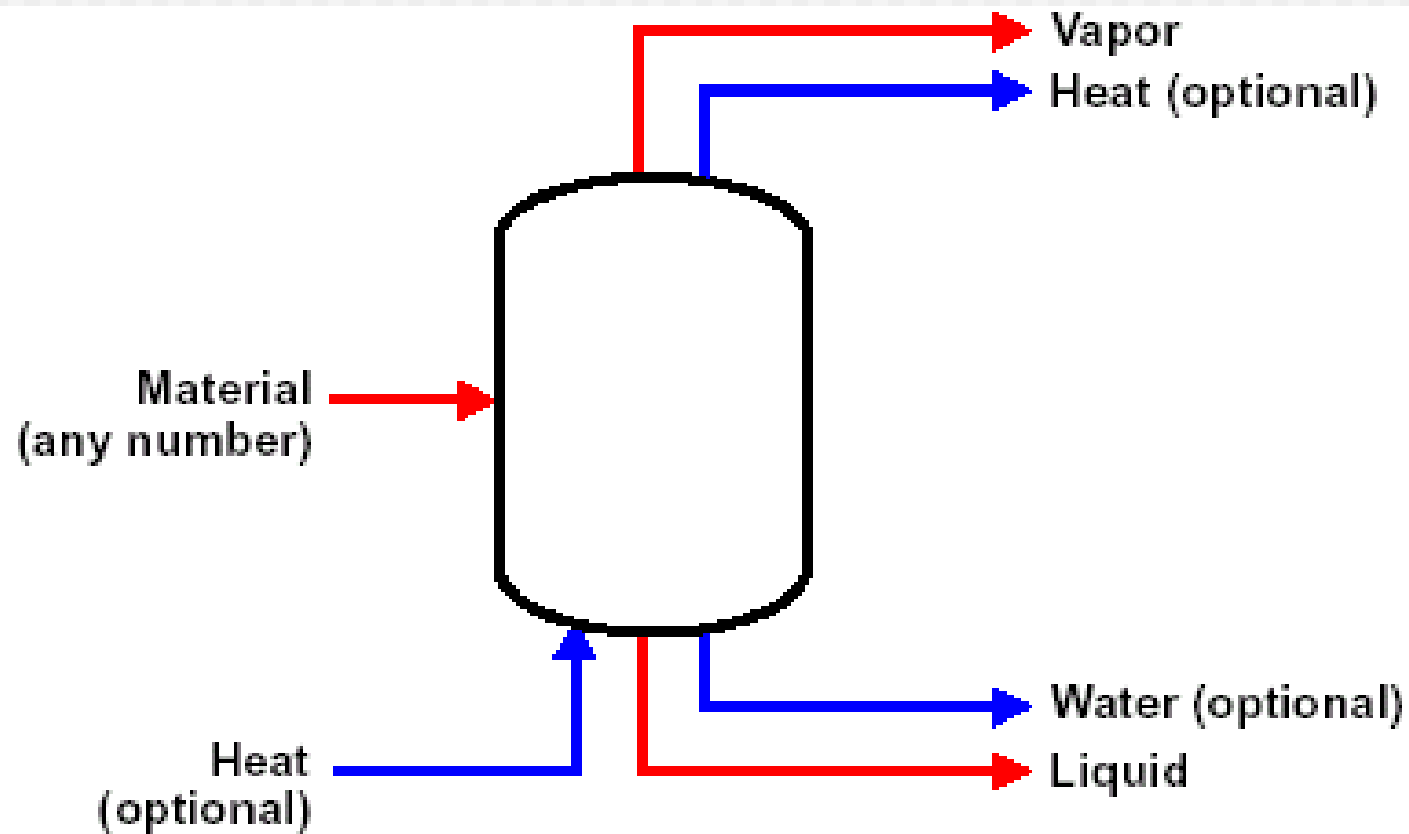
Flash2—两相闪蒸器

Flash2 模块执行给定热力学条件下的汽-液平衡或汽-液-液平衡计算，输出一股汽相和一股液相产物。用于模拟闪蒸器、蒸发器、气液分离器等。

Flash2—两相闪蒸器



Flash2—模块连接



Flash2—模块参数设置

Flash2 模块的模型参数有 **3** 组:

1、闪蒸设定 (**Flash Specifications**)

(1) 温度 (**Temperature**)

(2) 压力 (**Pressure**)

(3) 蒸气分率 (**Vapor Fraction**)

(4) 热负荷 (**Heat Duty**)

从以上 **4** 个参数中选定 **2** 个。

Flash2—模块参数设置

The screenshot displays the Flash2 software interface. On the left is a tree view showing the project structure. The main window is titled 'Input' and 'METCBAR'. The 'Specifications' tab is selected and highlighted with a red circle. Below the tabs, a 'Flash specifications' table is visible, with a dropdown menu open for the 'Pressure' row. The dropdown menu lists 'Pressure', 'Vapor fraction', and 'Heat duty'. The 'Temperature' row is set to 'C' and the 'Pressure' row is set to 'bar'. The 'Input' block 'B1' is expanded in the tree view, showing various options like 'Hcurves', 'Dynamic', 'Block Options', 'Results', 'EO Variables', 'EO Input', and 'Spec Groups'.

Input

METCBAR

Specifications Flash Options Entrainment Utility

Flash specifications

Temperature		C
Pressure		bar
Pressure		
Vapor fraction		
Heat duty		
Vapor-Liquid		

Setup
Components
Properties
Flowsheet
Streams
Utilities
Blocks
B1
Input
Hcurves
Dynamic
Block Options
Results
EO Variables
EO Input
Spec Groups

Flash2—模块参数设置

2、有效相态 (**Valid Phase**)

(1) 汽-液相 (**Vapor-Liquid**)

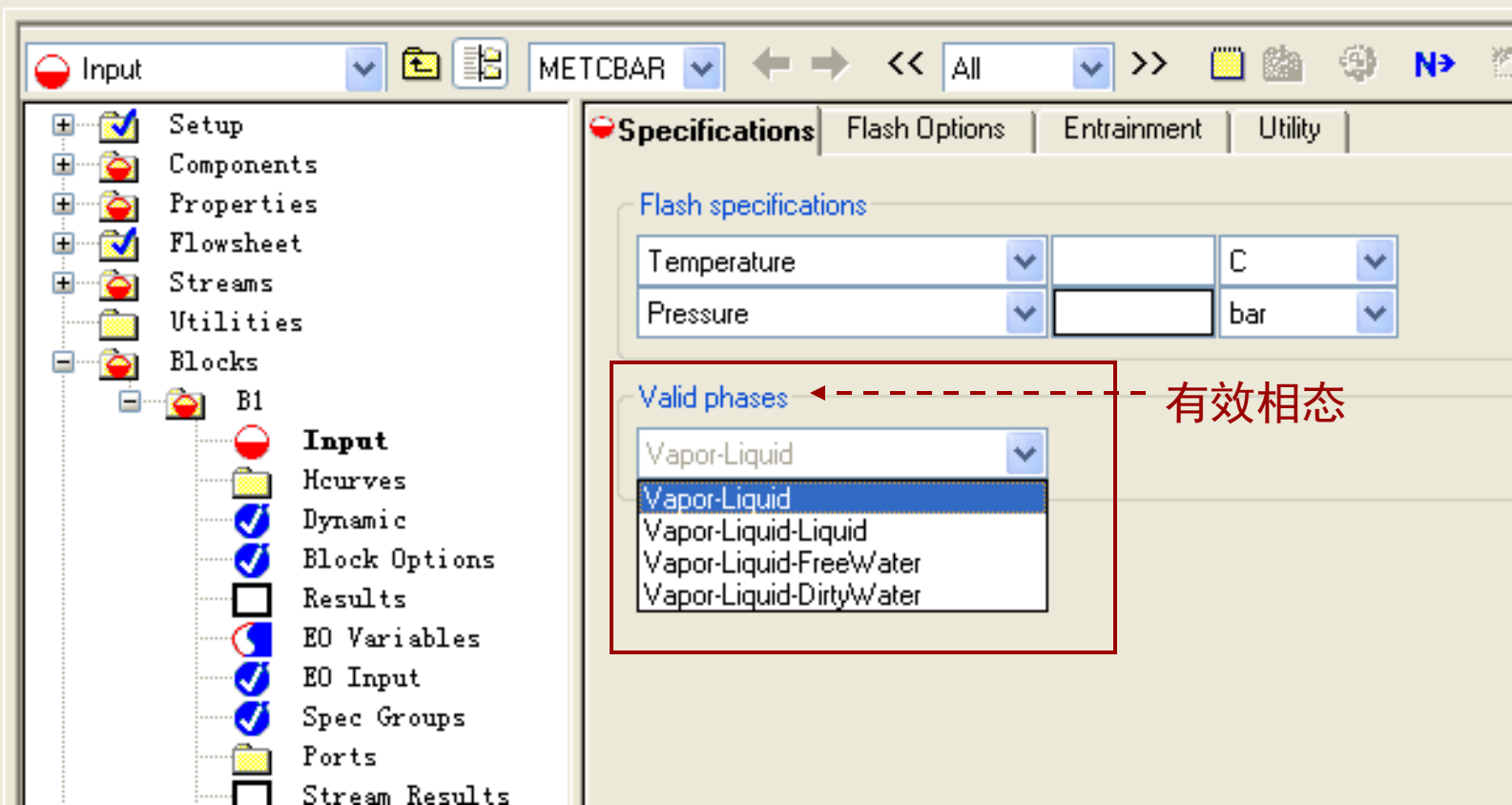
(2) 汽-液-液相 (**Vapor-Liquid-Liquid**)

(3) 汽-液-游离水相

(**Vapor-Liquid-Free Water**)

从以上 **3**个参数中选定 **1** 个。

Flash2—模块参数设置



Flash2—模块参数设置

3、液沫夹带

(Liquid Entrainment in Vapor Stream)

液相被带入汽相中的分率。

Flash2—模块参数设置

Input

METCBAR

Specifications Flash Options **Entrainment** Utility

Liquid entrainment in vapor stream

Liquid entrainment: 默认值为 0

Solid entrainment in vapor stream for each substream

Substream	Entrainment

Setup
Components
Properties
Flowsheet
Streams
Utilities
Blocks
 B1
 Input
 Hourves
 Dynamic
 Block Options
 Results
 EO Variables

Flash2 — 应用示例 (1)

流量为 **1000 kg/hr**、压力为 **0.11 MPa**、含乙醇 **70 %w**、水 **30 %w** 的饱和蒸汽在蒸汽冷凝器中部分冷凝，冷凝物流的汽/液比（摩尔）**=1/3**。求离开冷凝器的汽、液两相的温度和组成。

Flash2 — 应用示例 (2)

流量为 **1000 kg/hr**、压力为 **0.5 MPa** 温度为 **120°C**、含乙醇 **70 %w**、水 **30 %w** 的物料绝热闪蒸到 **0.15 MPa**。
求离开闪蒸器的汽、液两相的温度、流量和组成。

Flash2 — 应用示例 (3)

流量为 **1000 kg/hr**、压力为 **0.2 MPa** 温度为 **20°C**、含丙酮 **30%w**、水 **70%w** 的物料进行部分蒸发回收丙酮，求丙酮回收率为 **90%** 时的蒸发器温度和热负荷以及汽、液两相的流量和组成。

灵敏度分析——Sensitivity

在进行过程设计和分析时，常常需要了解某些过程变量受其它过程变量影响的敏感程度，ASPTEN Plus为此提供了一个非常有用的分析工具：模型分析工具(Model Analysis Tools)下的灵敏度(Sensitivity)对象。

灵敏度分析——Sensitivity

The screenshot displays a software interface for sensitivity analysis. The left sidebar shows a tree view of the project structure. The 'Model Analysis Tools' folder is expanded, and the 'Sensitivity' sub-folder is highlighted with a red oval. The main window shows a table with the following data:

Flowsheet variable	Definition
YACTON	Mass-Frac Stream=GOUT Substream=MIXED Component=C3H60
*	

At the bottom of the window, there are buttons for 'New...', 'Edit', 'Delete', and 'Copy'.

灵敏度分析——步骤1-3

创建灵敏度对象时，按以下步骤操作：

- 1、从数据浏览器右侧的对象管理器 (Object Manager) 中点击新建 (New) 按钮；
- 2、在弹出对话框中为新对象指定一个识别号 (ID)；
- 3、在定义 (Define) 表单中点击新建 (New) 按钮，创建灵敏度对象所需的变量；

灵敏度分析——步骤1-2

The screenshot displays the 'Sensitivity' tool configuration in a software interface. The left pane shows a tree view with 'Sensitivity' selected under 'Model Analysis Tools'. The right pane shows the 'Object manager' table with one entry: S-1, Results Available.

Name	Status
S-1	Results Available

A 'Create new ID' dialog box is open, showing 'Enter ID:' with the value 'S-2' entered. A red arrow labeled '2' points to the input field. A red arrow labeled '1' points to the 'New...' button in the 'Object manager' pane. A red note next to the dialog box says '系统会自动给出ID号' (The system will automatically give the ID number).

1

2

系统会自动给出ID号

灵敏度分析——步骤4-5

- 4、在弹出对话框中输入新变量的变量名 (Variable name)；
- 5、在变量定义 (Variable Definition) 对话框中的下拉式选择框中选择变量的类别 (Category)、类型 (Type)、流股 (Stream) 或模块 (Block) 代号，并指定具体变量 (Variable)。

灵敏度分析——步骤3-4

The screenshot displays the Aspen Plus software interface. On the left, a tree view shows the project structure, with 'Sensitivity' under 'Model Analysis Tools' circled in red. The main window shows the 'Define' tab, which contains a table for defining flowsheet variables. A 'Create new variable' dialog box is open, prompting the user to 'Enter variable name:'. A red arrow labeled '3' points to the 'New...' button, and another red arrow labeled '4' points to the input field in the dialog box. The text '定义因变量' (Define dependent variable) is written in red next to the '4'.

Flowsheet variable	Definition
*	

3 → New... Edit Delete Copy
Move Up Move Down Paste

4 → Enter variable name: OK Cancel

定义因变量

灵敏度分析——步骤5

The screenshot displays the Aspen Plus interface during a sensitivity analysis setup. The left-hand tree view shows the project hierarchy, with 'Sensitivity' under 'Model Analysis Tools' circled in red. The main window shows the 'Define' tab with a table of flowsheet variables:

Flowsheet variable	Definition
YACTON	Mass-Frac Stream=C
*	

The 'Variable Definition' dialog box is open, showing the configuration for the variable 'YACTON'. The 'Category' section has 'All' selected. The 'Reference' section is configured as follows:

- Type: Mass-Frac
- Stream: GOUT
- Substream: MIXED
- Component: C3H6O

A red arrow points from the number '5' to the 'Category' section of the dialog box. Below the arrow, the text '确定因变量类型' (Determine dependent variable type) is written in red. At the bottom of the dialog box, the text 'Access a component mass fraction.' is visible.

灵敏度分析——步骤6-7

步骤6：在变化 (Vary) 表单中输入调节变量 (Manupulated variable) 的类型、名称和具体变量 (variable), 并指定调节上、下限 (Upper/Lower limits) 和增量 (Incr)。

步骤7：在列表 (Tabulate) 表单中输入需要进行灵敏度分析的列表变量 (Tabulated variable) 或组合变量的表达式 (Expression) ，以及列表时的列序号 (Column No.)。

灵敏度分析——步骤6

The screenshot displays the Aspen Plus software interface for sensitivity analysis. The left sidebar shows a tree view with 'Input' selected under 'Model Analysis Tools'. The main window is in the 'Sensitivity' tool, with the 'Vary' tab active. A red box highlights the 'Manipulated variable' section, which includes the following fields:

- Cases: Variable no: 1 Disable variable
- Manipulated variable:
 - Type: Block-Var
 - Block: FLASH2
 - Variable: ENTRN
 - Sentence: PARAM
- Values for varied variable:
 - List of values: 0.05 | 0.1 | 0.15
 - Overall range
- Report labels:
 - Line 1: Line 2:
 - Line 3: Line 4:

A red arrow points to the 'Variable' dropdown menu, labeled with the number '6' and the text '选择调节变量' (Select manipulated variable).

灵敏度分析——步骤7

Input

METCBAR

Define Vary **Tabulate** Fortran Declarations Optional Cases

Column No.	Tabulated variable or expression
2	YACTON
*	

7 结果列表格式

因变量名称

序列号

Model Analysis Tools

- Sensitivity
- S-1

Input Results

Optimization Constraint

灵敏度分析——结果显示

从左侧的灵敏度对象下的结果 (Results) 项目中查看结果。右侧的汇总 (Summary) 表单中按照指定的列序号列表给出调节变量和列表变量的对应值。

灵敏度分析——结果显示

The screenshot displays a software interface for sensitivity analysis. On the left, a tree view shows the project structure, with 'Results' selected under 'Model Analysis Tools'. On the right, a 'Summary' table is displayed, showing the results of the sensitivity analysis for five different cases. The table is circled in red.

Row / Case	Status	VARY 1	YACTION
1	OK	0.05	0.56830111
2	OK	0.1	0.54048548
3	OK	0.15	0.51551388
4	OK	0.2	0.49297133
5	OK	0	0.59947599

变量关系图——Plot

在察看和分析灵敏度分析的列表数据时，用图形描述的函数关系曲线常常能让我们更直观和全面地了解过程变量间的依赖趋势，ASPTEN Plus 为此提供了绘图 (Plot) 功能，可以将列表数据中的任意两列绘制成 $X \sim Y$ 曲线图。

Plot——作图步骤

在列表数据中选中一列，从窗口菜单Plot项的下拉框里选择X轴变量 (X-Axis Variable)，再选中列表数据的另一列，从窗口菜单Plot项的下拉框里选择Y轴变量 (Y-Axis Variable)，然后点击窗口菜单Plot项的下拉框里的显示绘图 (Display Plot)，即可得到曲线图。

Plot——作图步骤

The screenshot shows the Aspen Plus 2000 interface. The 'Plot' menu is open, displaying the following options:

- Plot Type...
- X-Axis Variable (Ctrl+Alt+X)
- Y-Axis Variable (Ctrl+Alt+Y)
- Parametric Variable (Ctrl+Alt+Z)
- Display Plot (Ctrl+Alt+P)
- Add New Curve...
- Plot Wizard... (Ctrl+Alt+W)

The 'Plot Wizard...' option is selected, leading to a table with the following data:

Case	FLASH2	PARAM	ENTRN
1	OK	0.05	0.56830111
2	OK	0.1	0.54048548
3	OK	0.15	0.51551388
4	OK	0.2	0.49297133
5	OK	0	0.59947599

Plot——作图步骤

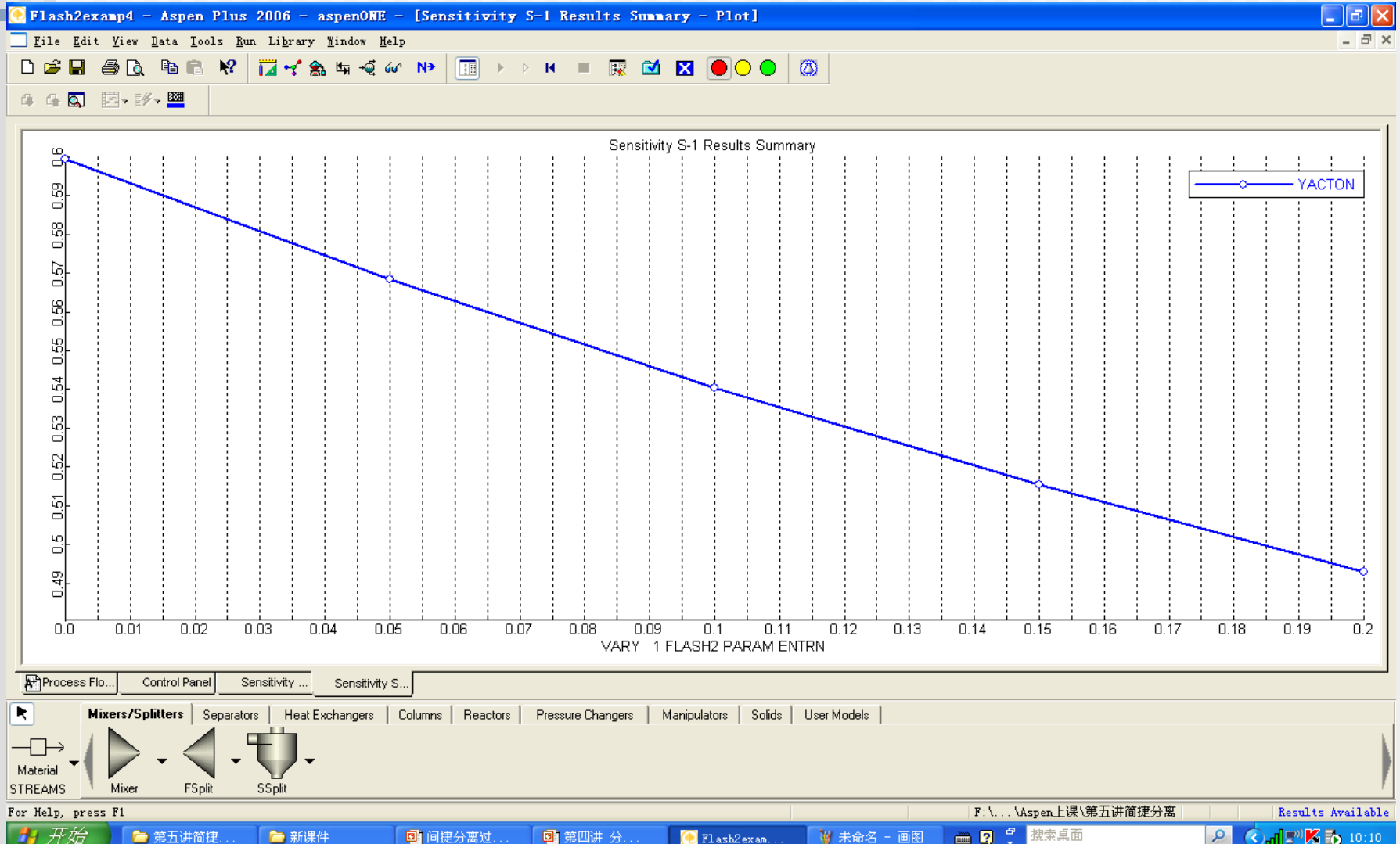
The screenshot displays a software interface with a menu bar at the top: File, Edit, View, Data, Tools, Run, Plot, Library, Window, Help. The Plot menu is open, showing the following options:

- Plot Type...
- X-Axis Variable Ctrl+Alt+X
- Y-Axis Variable Ctrl+Alt+Y** (highlighted with a red box)
- Parametric Variable Ctrl+Alt+Z
- Display Plot Ctrl+Alt+P
- Add New Curve...
- Plot Wizard... Ctrl+Alt+W

The background shows a tree view on the left with folders like Reactions, Convergence, Flowsheeting Options, and Model Analysis Tools. On the right, a table displays data for a case named FLASH2.

Case	FLASH2	PARAM	ENTRN
1	OK	0.05	0.56830111
2	OK	0.1	0.54048548
3	OK	0.15	0.51551388
4	OK	0.2	0.49297133
5	OK	0	0.59947599

Plot——结果显示



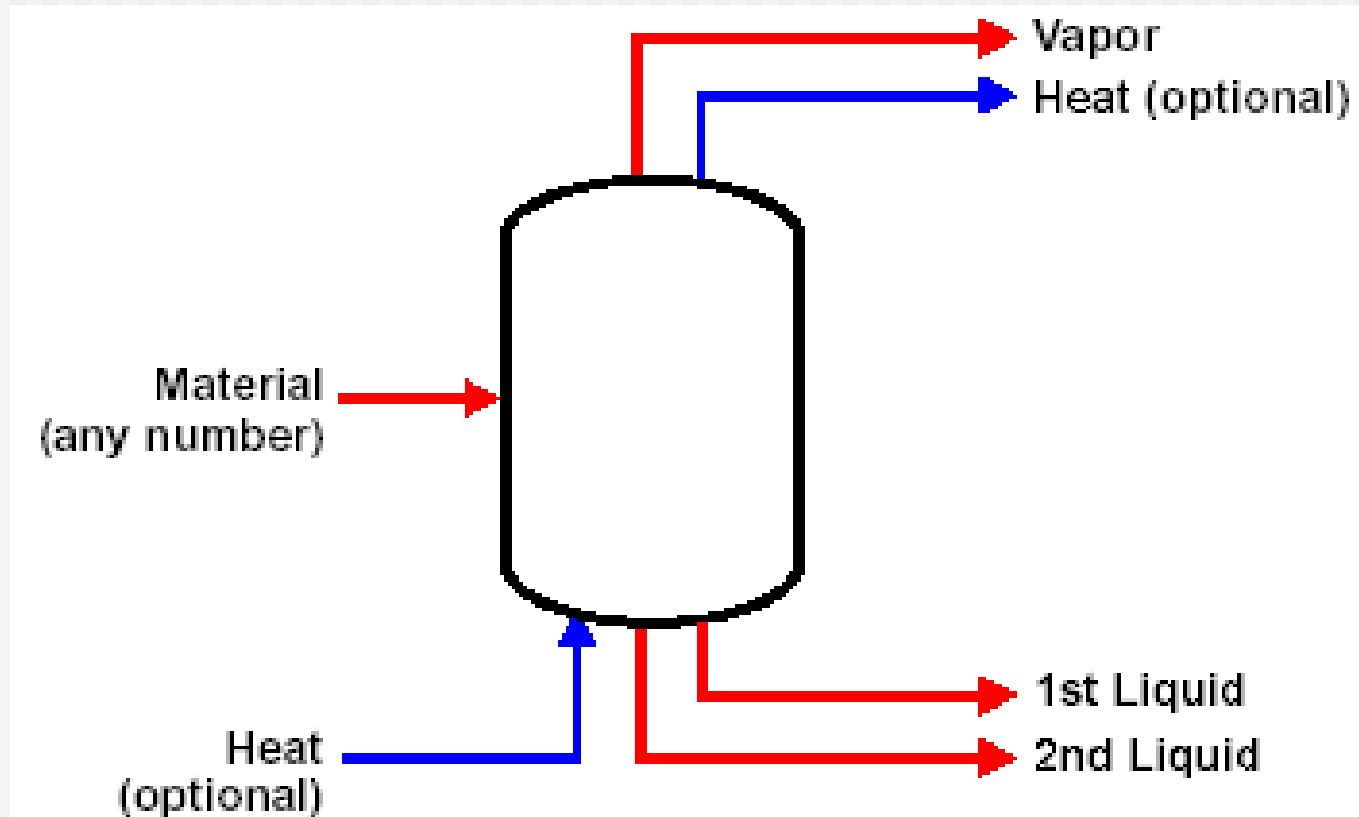
Flash2 — 应用示例 (4)

流量为 **1000 kg/hr**、压力为 **0.2 MPa** 温度为 **20°C**、含丙酮 **30%w**、水 **70 %w** 的物料进行部分蒸发回收丙酮，蒸发器热负荷为 **250 kW**。分析液沫夹带对汽相丙酮分率的影响。

Flash3—三相闪蒸器

Flash3 模块执行给定热力学条件下的汽-液-液平衡计算，输出一股汽相和两股液相产物。用于模拟闪蒸器、蒸发器、液-液分离器、汽-液-液分离器等。

Flash3—三相闪蒸器模块连接



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