30.   Excel Add-In Functions

30.1.   Getting started

With HSC Add-In functions it is possible to use the HSC database directly under Microsoft Excel 97 - 2013 and in that way carry out several thermochemical and other types of calculations. In order to use these functions in Excel they must, however, first be activated. The steps required to activate the Add-In functions might vary in different versions of Excel. The following shows the steps for Excel 2013.

Implementing Add-In functions in Excel 2013
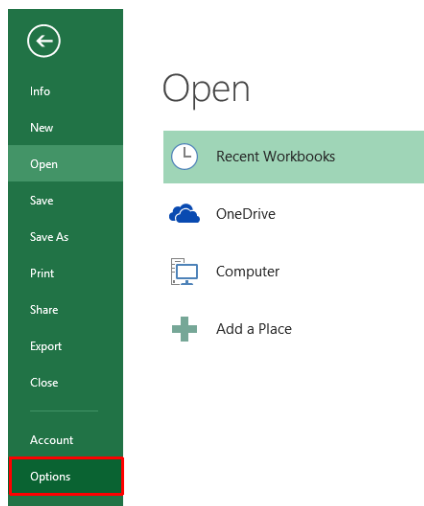
1.   Open Excel
2.   Select **File – Options**

Fig. 1. Location of Options in Excel 2013.
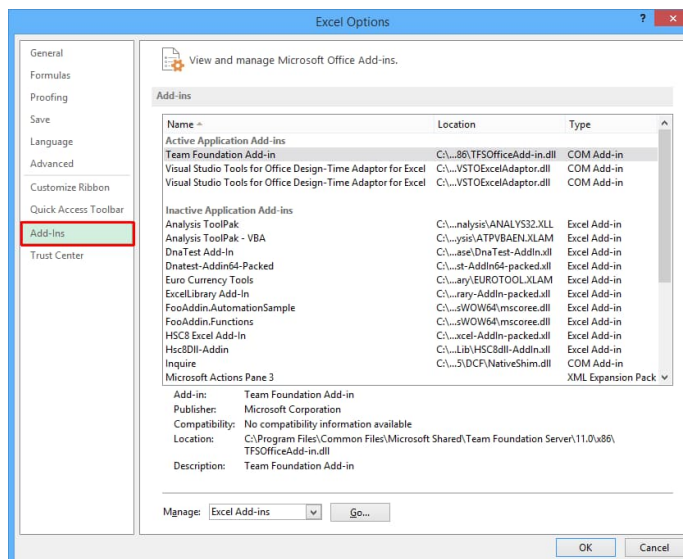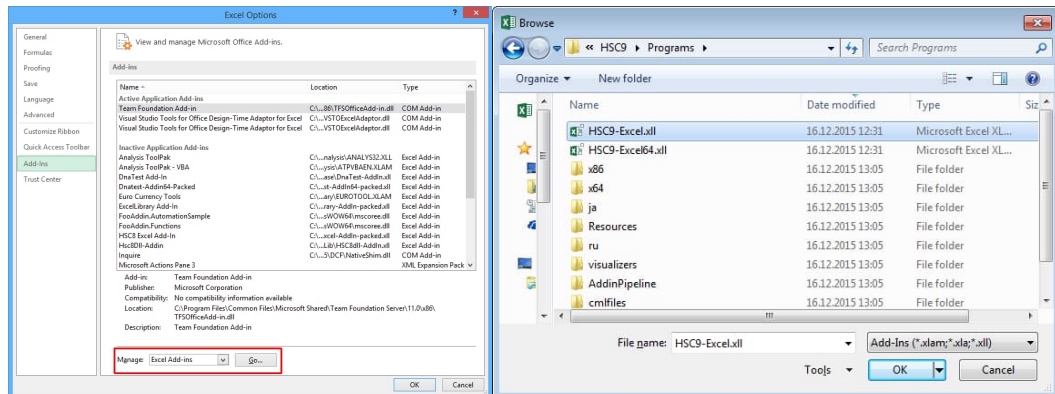
3.   Select **Add-Ins**

Fig. 2. Location of Add-Ins in Excel 2013.

4. Select **Excel Add-Ins** and click **Go…**

5. Select **Browse…** and locate HSC10-Excel.xll from your **HSC10\Programs** folder.

6. See that "HSC10-Excel.xll" is selected and click **OK**.

Fig. 3. Location of Add-ins Go…button in Excel 2013. Browse to find HSC-Excel.xll file.

30.2. Updating XLS files which use old HSC Add-In functions

1. Turn off the old HSCX (X is version number) Add-in Functions using Excel "**File – Options – AddIns**" dialog

2. Turn on the new HSC Add-in Functions using Excel "**File – Options – AddIns**" dialog

3. Remember to save the updated XLS file.

30.3. Brief description of the functions

The "AddInSample.xlsx" sample file offers the fastest way to start using HSC Add-In functions. You can find it in the HSC folder as:

C:\Program Files (x86)\HSC10\AddIns\AddInSample.xlsx

The Add-In functions are used in the same way as functions in general under MS Excel. For example, by writing **"=H("H2O";25)"** user gets enthalpy of water at user specified temperature. User can also type **"=H(A1;A2)"** the enthalpy for the species in cell A1 and at the temperature in cell A2, is returned. To view all existing functions, simply select **"Insert, Function"** from the main menu and then choose the **"HSC10 Excel Add-In"** category. The list will now show all the available HSC functions. NOTE! Depending on computers region and language setting user may need to use list separator "," instead of ";". **Table 1** shows some typical add-ins functions.

Table 1. List of some handy Add-In functions

MW(Species)	- Molecular weight, =MW("H2O")
H(Species/Reaction;temperature)	- Enthalpy, =H("H2(g)";25)
S(Species/Reaction;temperature)	- Entropy, =S("CO2(g)";50)
G(Species/Reaction;temperature)	- Gibbs energy, =G("C+O2(g) = CO2(g)";25)
K(Reaction;temperature)	- Equilibrium constant, =K("Fe+S=FeS";500)
BAL(Reaction;multiplier)	- Balance reaction, =BAL("C+O2(g) = CO(g)";0.5)
WTP(Species1;Species2)	- Species1 content (wt-%) in Species2, =WTP("V";"VO")
EnergyU()	- Active energy unit, =EnergyU()
TempU()	- Active temperature unit, =TempU()
PresU()	- Active pressure unit, = PresU()

For more examples open a useful Excel example file, which is located in the catalog "\AddIns" in your HSC installation directory. The example, called "AddInSample.xlsx", can be viewed after the Add-Ins have been made available (described in section 30.1).

The functions are all collected in the column "Function" and their return values under "Return value". A red font indicates the input values with a short description of every function shown on the right. This example provides an easy method for testing the functions and also provides practice in learning how to use them.

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HSC – Excel Add-Ins

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30.4.   Stream Equilibrium function (Array functions)

The array functions are created differently than normal spreadsheet functions. The most important array function of HSC Sim is **StreamEQ,** which calculates the amounts of species in the equilibrium state at a given temperature and pressure.

	A	B	C	D	E
			C4	f_x	
1	Temperature		1500	°C	
2	Pressure		1	bar	
3	SPECIES:	Input	Output		
4	§ PHASE 1:	25		°C	
5	CO(g)	0		kmol	
6	CO2(g)			kmol	
7	N(g)			kmol	
8	N2(g)	3.02		kmol	
9	NO(g)			kmol	
10	N2O3(g)			kmol	
11	N2O4(g)			kmol	
12	N2O5(g)			kmol	
13	O2(g)	0.8		kmol	
14	§ PHASE 2:	25		°C	
15	C	1		kmol	
16					

Fig. 4. Selection for array function.

You can create an array function in MS Excel and HSC Sim using the same procedure:

1.   Create a continuous list of phases and species in one column. N.B! The phase name string must always start with **§ or §§**, see **Fig. 4** and note below.
2.   Specify the temperatures of the phases in the next column on the § phase row.
3.   Specify the input amounts (moles) of the species in the next column.
4.   Select the array function cell range, see **Fig. 4**.
5.   Type the array function: =StreamEQ(A4:A15;B4:B15;C1;C2), see **Fig. 5**.
6.   Hold down the Crtl + Shift keys and press Enter, see **Fig. 6**.
7.   The array function is ready if it is inside brackets, see **Fig. 6**.

See C:\Program Files (x86)\HSC10\AddIns\AddInSample.xlsx for more examples.

Please note that the array function cell range must be continuous; it is like a solid and fixed block within the spreadsheet. Do not break this cell range with non-continuous operations such as copy-paste, insert rows, delete rows, etc.

Note:
§ = Mixture Phase name flag
§§ = Pure Substance Phase name flag

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	SEARCH		f_x	=StreamEQ(A4:A15;B4:B15;C1;C2)		
	A	B	C	D	E	F
1	Temperature		1500	°C		
2	Pressure		1	bar		
3	SPECIES:	Input	Output			
4	§ PHASE 1:	25	=StreamEQ(A4:A15;B4:B15;C1;C2)			
5	CO(g)	0		kmol		
6	CO2(g)			kmol		
7	N(g)			kmol		
8	N2(g)	3.02		kmol		
9	NO(g)			kmol		
10	N2O3(g)			kmol		
11	N2O4(g)			kmol		
12	N2O5(g)			kmol		
13	O2(g)	0.8		kmol		
14	§ PHASE 2:	25		°C		
15	C	1		kmol		
16						

Fig. 5. Type the array function.

	C4		f_x	{=StreamEQ(A4:A15;B4:B15;C1;C2)}		
	A	B	C	D	E	F
1	Temperature		1500	°C		
2	Pressure		1	bar		
3	SPECIES:	Input	Output			
4	§ PHASE 1:	25	1500.00000000	°C		
5	CO(g)	0	0.40000851	kmol		
6	CO2(g)		0.59999149	kmol		
7	N(g)		0.00000000	kmol		
8	N2(g)	3.02	3.01999596	kmol		
9	NO(g)		0.00000808	kmol		
10	N2O3(g)		0.00000000	kmol		
11	N2O4(g)		0.00000000	kmol		
12	N2O5(g)		0.00000000	kmol		
13	O2(g)	0.8	0.00000022	kmol		
14	§ PHASE 2:	25	1500.00000000	°C		
15	C	1	0.00000000	kmol		
16						

Fig. 6. Hold down the Crtl + Shift keys and press Enter.

30.5. Using the MineralProperty Add-In function

The Add-In provides the MineralProperty function, which accesses the HSC Mineral Database and enables you to query the properties of the stored minerals.

The format for the formula is MineralProperty(<MineralName>, <PropertyName>).

As with any Excel functions you can use references and other formulae to provide the two parameters for the MineralProperty function, e.g. MineralProperty(A1,B1), MineralProperty("Pyrite",B1) and so on. See the example workbook ..\AddIns\AddInSample_Mineral.xls for more examples and information:

Available functions:

The HSC add-in provides the following functions to facilitate access to the mineral properties.

Function	Parameters	Description
=MineralC(MN, EL)	MN=mineral name or mineral symbol EL=element abbreviation	Returns the weight % of the specified element in the mineral
=MineralCode(MN)	MN=mineral name or mineral symbol	Returns the mineral symbol for the specified mineral
=MineralColor(MN)	MN=mineral name or mineral symbol	Returns the color for the specified mineral
=MineralDensity(MN)	MN=mineral name or mineral symbol	Returns the density for the specified mineral
=MineralElementWt(MN;EL)	MN=mineral name EL=element abbreviation	See: MineralC
=MineralFormula(MN)	MN=mineral name or mineral symbol	Returns the chemical formula of the specified mineral
=MineralHardness(MN)	MN=mineral name or mineral symbol	Returns the hardness for the specified mineral
=MineralLuster(MN)	MN=mineral name	Returns the luster for the specified mineral
=MineralName(MN)	MN=Mineral symbol or mineral name	Returns the mineral name for the mineral specified symbol
=MineralProperty(MN;PR)	MN=mineral name or mineral symbol PR=property name (field name in <Mineralchemistry table)	Returns any of the fields in the <MineralChemistry table for the specified mineral. See section: Mineralproperty
=MineralSG(MN)	MN=mineral name or mineral symbol	Returns the specific gravity (density) for the specified mineral

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MineralProperty

The MineralProperty function can be used to fetch the data from the fields in the <Mineralchemistry and Minerals tables for a given mineral. The available fields are listed below:

Data field	Explanation	Example
Code	Mineral symbol (i.e. abbreviation)	=mineralproperty("Pyrite";"code")
Formula	Chemical formula of the mineral	=mineralproperty("Pyrite";"formula")
Density		=mineralproperty("Pyrite";"density")
Hardness		=mineralproperty("Pyrite";"hardness")
Color		=mineralproperty("Pyrite";"color")
Luster		=mineralproperty("Pyrite";"luster")
Group		=mineralproperty("Pyrite";"group")
Chemical elements	These are returned in elemental form, not as oxides.	=mineralproperty("Pyrite";"Fe") =mineralproperty("Pyrite";"S")
Location	Sampling location or [stoichiometric] if the mineral has been entered from the chemical formula and not actually assayed	=mineralproperty("Pyrite";"location")
ID	Database ID of the mineral	=mineralproperty("Pyrite";"ID")
Elements	Backslash-delimited string represents the individual elements comprising the mineral in the format, e.g. \Si\O\	=mineralproperty("Pyrite";"elements")
Database	Database in which the mineral has been stored. Usually HSC, but depending on the actual use it can take any other value. Use with caution.	=mineralproperty("Pyrite";"database")

**Fig. 7.** A sample Excel sheet using the features of the Add-In.

30.6. HSC AddIn functions

Some of the AddIn functions are available in HSC Chemistry spreadsheets, but not in MS Excel. Currently, StreamX is such a function:

Function	**StreamX**
Syntax	StreamX(StreamName;ParticlesRange;Variable)
Examples	StreamX(E$6;$E$56:$E$97;$B8)
	StreamX("ROM";$E$56:$E$97;"SiO2")

Explanation   Returns the value of the variable, e.g. SiO2 content of the stream calculated according to particles. Note that particle data can be corrected to be in harmony with the chemical and mineral composition of the bulk feed.

Applications   StreamX functions are used in Mineral Based Models

Other HSC AddIn functions are **StreamX**, **RecoveryX, ParticleRecX, FractionX, MineralX**.

30.7.   Changing measurement units
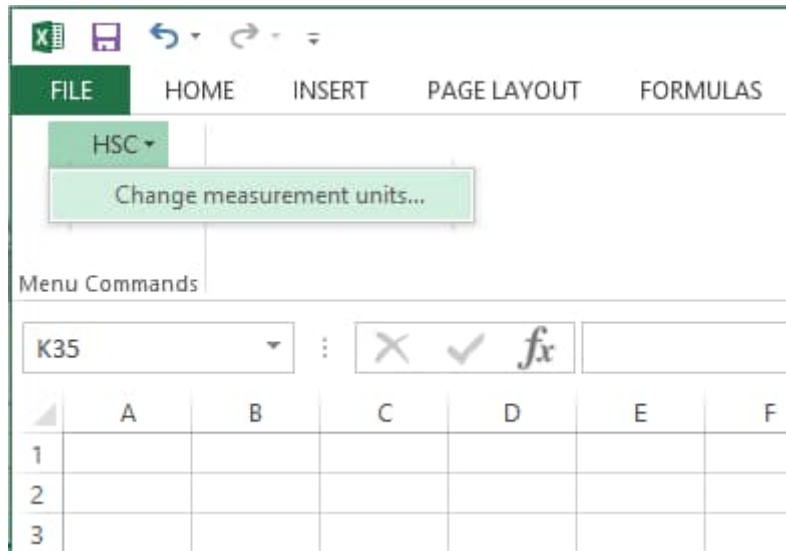
The user may change the default energy, temperature and pressure measurement units using the "Change measurement units…" dialog. The HSC menu can be accessed from the ADD-INS tab (Excel 2013).

After changing the measurement units, the workbook is automatically recalculated.

30.8.   Changing Databases

You can change databases by using the DB (H, S and Cp Database) or Geo (Mineral Database) programs. For more information, please refer to Chapter 28 - HSC Databases.