

Enabling Advanced Problem Solving in Spreadsheets with Access to Physical Property Data

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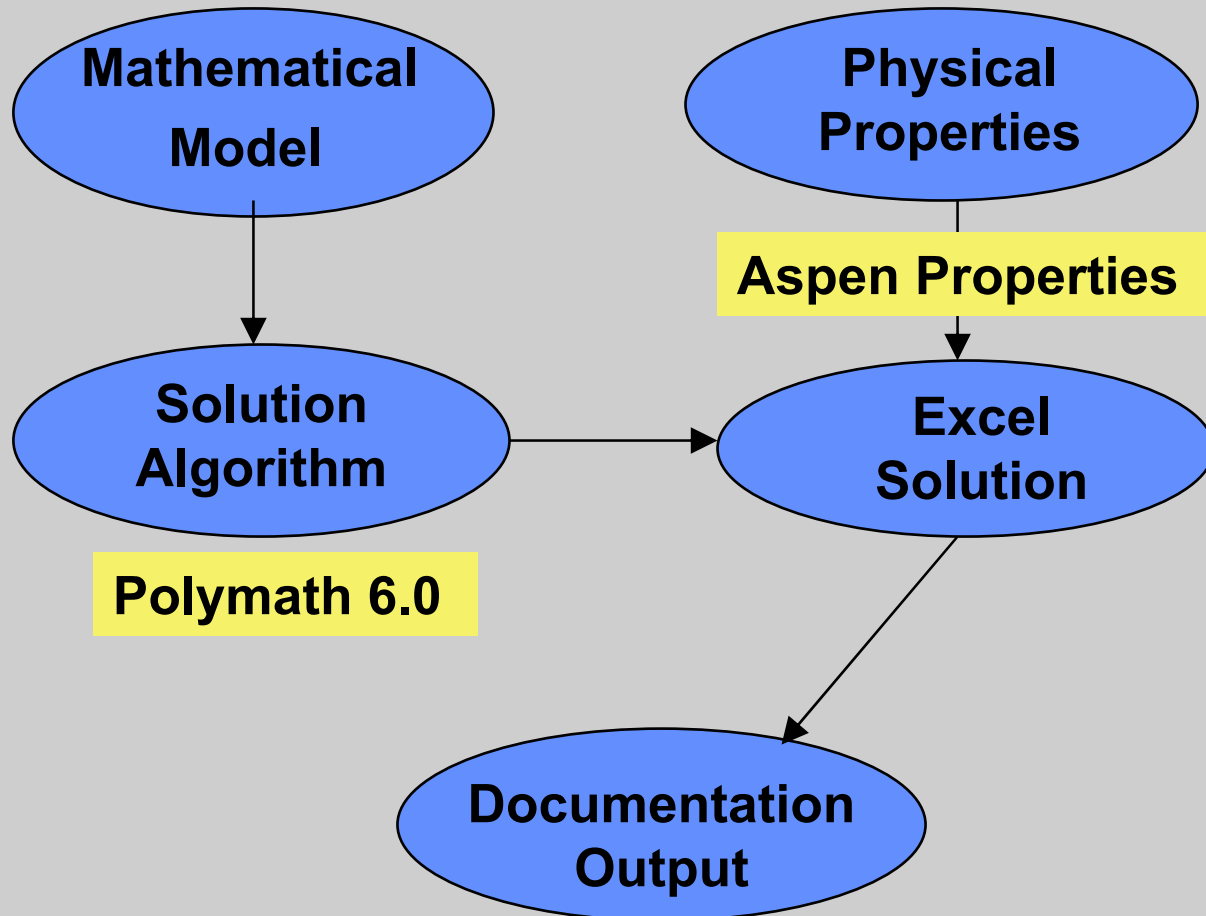
This Paper Deals with Increasing Engineering Productivity with a Novel Combination of Software Tools

- **Polymath© (advanced problem formulation)**
- **Excel™ (familiar spreadsheet environment)**
- **Aspen Properties™ Add-In for Excel (accurate physical property data)**

Demonstrate: Engineers and technical personnel at their personal computers can now efficiently solve much more sophisticated problems while calling upon accurate physical property data, all within the friendly spreadsheet environment of Excel.

A New Paradigm in Desktop Problem Solving Involving Polymath, Aspen Properties, and Excel

Provides Advanced Problem Solutions





POLYMATH Software Presents

POLYMATH 6.0

Numerical Computation Package

A Significant New Release

- Extremely Easy-to-Use
- Excellent Problem Solving Capabilities
- Now Works to Provide Excel Solutions
 - Automated Export of Problems to Excel
 - Enables Stand-Alone Excel Calculations
 - Provides Differential Equations Solver for Excel
 - Promotes the Use of Aspen Properties within Excel Calculations



POLYMATH 6.0

Professional problem solving capabilities include:

- ☀ Linear Equations - up to 264 simultaneous equations**
- ☀ Nonlinear Equations - up to 600 simultaneous nonlinear and explicit algebraic equations**
- ☀ Differential Equations - up to 600 simultaneous ordinary differential and explicit algebraic equations**
- ☀ Data analysis and Regression - up to 1000 data points with capabilities for linear, multiple linear, and nonlinear regressions with extensive statistics plus polynomial and spline fitting with interpolation and graphing capabilities**



POLYMATH 6.0 features include:

- **EASE OF USE WITHOUT ANY PROGRAMMING LANGUAGES OR CONTROL LANGUAGES TO REMEMBER**
- **STANDARD WINDOWS EDITING**
- **EXTENSIVE USER ALGORITHM SELECTION AND CONTROL**
- **EXECUTION WITH ALL 32-BIT WINDOWS OPERATING SYSTEMS**
- **COMPATIBILITY WITH PREVIOUS VERSIONS**
- **THREE ON-BOARD UTILITIES: POWERFUL CALCULATOR, UNIT CONVERTER, AND EXTENSIVE ENGINEERING CONVERSION FACTORS**
- **EXTENSIVE ON-LINE DOCUMENTATION**
- **AUTOMATIC PROBLEM EXPORT TO EXCEL – EXCEL ADD-IN FOR DIFFERENTIAL EQUATIONS**
- **MATLAB OUTPUT GIVING ORDERED AND FORMATTED EQUATIONS**

Demonstration Problem – Cocurrent Operation of a Double Pipe Heat Exchanger

One mode of operation of a double-pipe heat exchanger, which is diagrammed in Figure 6–15 for cocurrent operation, is to cool a steady stream of m' lb_m/h of fluid in the tube from inlet temperature T_1 to an exit temperature T_2 . The fluid in the shell side with a flow rate of m lb_m/h is correspondingly heated from inlet temperature T'_1 to exit temperature T'_2 .

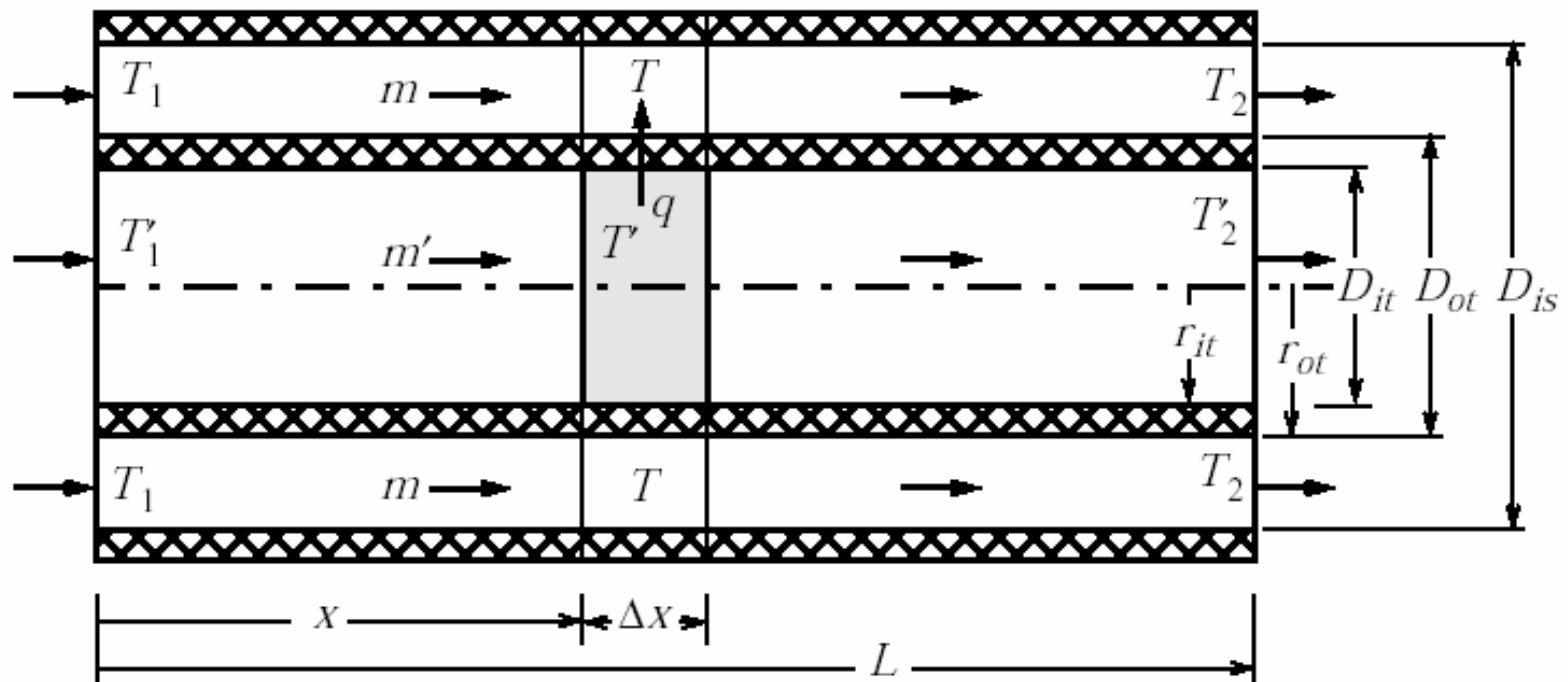


Figure 6–15 Double-Pipe Heat Exchanger for Cocurrent (Parallel) Flow

Some Problem Details – Local Heat Transfer Coefficient

The following equation represents the local heat transfer coefficient where the exponent $n = 0.4$ for heating and 0.3 for cooling

$$\frac{hD}{k} = 0.023 \left(\frac{Dv\rho}{\mu} \right)^{0.8} \left(\frac{C_p\mu}{k} \right)^n$$

Overall Heat Transfer Coefficients The local overall heat transfer coefficient based on the inside area is calculated from (Geankoplis⁴)

$$U_i = \frac{1}{1/h_i + ((r_{ot} - r_{it})D_{it})/(k_t D_{t\ln}) + D_{it}/(D_{ot}h_o)} \quad (6-66)$$

where t represents the tube wall material and dimensions. The $D_{t\ln}$ term is the log mean diameter (or area) for the tube wall.

Demonstration Problem – Differential Equations for Heat Exchanger

Cocurrent or Parallel Flow A differential energy balance on the tube fluid in concurrent flow in a manner similar to that detailed in Problem 6.8, with the prime indicating the fluid temperature or property of the higher temperature fluid, leads to

$$\frac{d}{dx}(T') = - \frac{U_i(\pi D_i)(T' - T)}{m' C_p'} \quad (6-64)$$

where the overall heat transfer coefficient U_i in $\text{btu/h}\cdot\text{ft}^2\cdot^\circ\text{F}$ is based on the inside area given by πD_i with the inside tube diameter D_i in ft. The initial condition for Equation (6-64) is just the inlet temperature T'_1 to the tube, and the final condition is the outlet temperature T'_2 from the tube.

Similarly, for the well insulated shell, a differential energy balance on the shell fluid in concurrent flow and the inside heat transfer area yields

$$\frac{dT}{dx} = \frac{U_i(\pi D_i)(T' - T)}{m C_p} \quad (6-65)$$

Demonstration Problem:

Calculate the required length of a concurrent double pipe heat exchanger with cooling water in the shell side and benzene in the tube side. The cooling water is available at 65 °F and has a flow that is three times that of the benzene. The configuration of the heat exchanger is given below:

Fluid	Flow <i>m</i> lb _m /h	Inlet <i>T</i> °F	Outlet <i>T</i> °F	Inside Tube		Outside Pipe	
				OD in.	BWG	Nominal Pipe, in.	Schedule
Benzene (liquid)	3000	150	80	7/8	16	1½	40

Entering the Problem into Polymath - Constant Properties

POLYMATH 6.0 Professional Release - [Ordinary Differential Equations Solver]

File Edit Format Program Examples Window Help

RKF45 Table Graph Report

Differential Equations: 2 Auxiliary Equations: 25 Ready for solution

$d(\text{TH2O})/d(x) = U_i * 3.1416 * D_{it} * (\text{TC6H6} - \text{TH2O}) / (m_{\text{H2O}} * C_{p\text{H2O}})$
 $\text{TH2O}(0) = 65$
 $d(\text{TC6H6})/d(x) = -U_i * 3.1416 * D_{it} * (\text{TC6H6} - \text{TH2O}) / (m_{\text{C6H6}} * C_{p\text{C6H6}})$
 $\text{TC6H6}(0) = 150$
 $x(0) = 0$
 $x(f) = 70.5$
 $D_{it} = 0.745 / 12$
 $\text{Dot} = (.745 + 2 * .065) / 12$
 $\text{Dis} = 1.610 / 12$
 $\text{Ds} = \text{Dis} - \text{Dot}$
 $\text{Dtlm} = (\text{Dot} - \text{Dit}) / \ln(\text{Dot} / \text{Dit})$
 $\text{rot} = \text{Dot} / 2$
 $\text{rit} = \text{Dit} / 2$
 $kt = 220$
 $m_{\text{C6H6}} = 3000$
 $m_{\text{H2O}} = 3 * m_{\text{C6H6}}$
 $C_{p\text{H2O}} = 1$ # Water Heat Capacity

Differential Equations Solver: Enter Differential Equation

Enter the differential equation:

$d(\text{TH2O}) / d(x) = U_i * 3.1416 * D_{it} * (\text{TC6H6} - \text{TH2O}) / (m_{\text{H2O}} * C_{p\text{H2O}})$

Set the initial value:

TH2O(0) = 65

Comment:

Clear Done Cancel

Ln 1 HeatExchangerConstantProperties.pol No Title

11:32 PM 10/14/2004 CAPS NUM



$\frac{d}{dt}$ $\times =$ $\frac{init}{final}$ RKF45 Table Graph Report

Differential Equations: 2 Auxiliary Equations: 25 Ready for solution

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CpH2O = 1 # Water Heat Capacity
muH2O = 2.5 # Water Viscosity
kH2O = 0.35 # Water Thermoconductivity
rhoH2O = 62.3 # Water Density
PrH2O = CpH2O * muH2O / kH2O # Water Prandtl Number
ReH2O = Ds * mH2O / (3.1416 * (Dis ^ 2 - Dot ^ 2) / 4) / muH2O # Water Reynolds Number
hH2O = kH2O * 0.023 * ReH2O ^ 0.8 * PrH2O ^ .4 / (Ds) # Water Heat Transfer Coefficient
CpC6H6 = 0.435 # Benzene Heat Capacity
rhoC6H6 = 51.8 # Benzene Density
muC6H6 = .88 # Benzene Viscosity
kC6H6 = 0.076 # Benzene Thermoconductivity
PrC6H6 = CpC6H6 * muC6H6 / kC6H6 # Benzene Prandtl Number
ReC6H6 = Dit * mC6H6 / (3.1416 * Dit ^ 2 / 4) / muC6H6 # Benzene Reynolds Number
hC6H6 = kC6H6 * 0.023 * ReC6H6 ^ 0.8 * PrC6H6 ^ .3 / (Dit) # Benzene Heat Transfer Coefficient
Ui = 1 / (1 / hC6H6 + ((rot - rit) * Dit) / (kt * Dtlm) + Dit / (Dot * hH2O)) # Overall Heat Transfer Coefficient
  
```

Ln 20 HeatExchangerConstantProperties.pol No Title

10:59 PM 10/14/2004 CAPS NUM

Aspen Properties Excel Calculator

Brings Physical Property Data to Excel

- **Pure component constants (MW, Normal boiling point).**
- **Vapor pressure at a specified temperature**
- **Pure component property at specified temperature and pressure**
- **Mixture properties for a specified mixture at given temperature and pressure**
- **Two and three phase flash, bubble and dew point calculations**

Preparing for Aspen Properties – Building the aprbkp file

Aspen Properties - Heat_exchange.aprbkp

File Edit View Data Tools Calculate Plot Window Help

Components - Data Browser

Components

- Setup
- Components
 - Specifications
 - Assay/Blend
 - Light-End Properties
 - Petro Characterization
 - Pseudocomponents
 - Attr-Comps
 - Henry Comps
 - UNIFAC Groups
 - Polymers
- Properties
- Chemistry
- Miscellaneous Options
- Results Summary

Selection Petroleum Nonconventional Databanks

Define components

Component ID	Type	Component name	Formula
▶ WATER	Conventional	WATER	H2O
BENZE-01	Conventional	BENZENE	C6H6
*			

Find Elec Wizard User Defined Reorder Review

Component ID. If data are to be retrieved from databanks, enter either Component Name or Formula. See Help.

For Help, press F1

C:\...enWorld 2004\Friday Paper

Input Changed

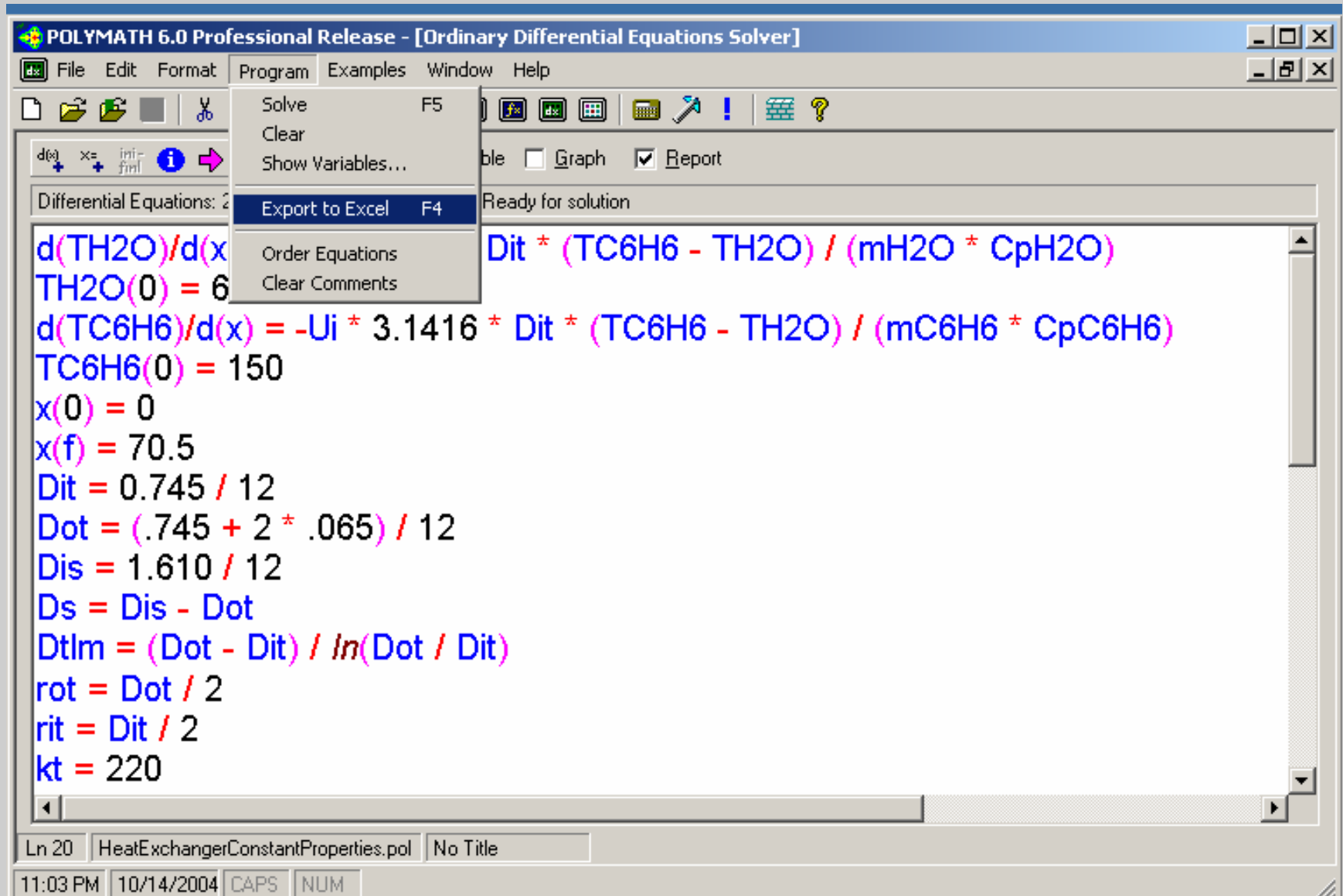
Setting Up Aspen Property Data in an Excel Spreadsheet Using Aspen Properties Add-In for Excel

The screenshot shows a Microsoft Excel spreadsheet titled "CutlipCocurr_CoolerAspenPropertiesSetup.xls". The spreadsheet contains the following data:

	A	B	C	D
1	Problem 6.9 in Cutlip and Shacham, Part a, Benzene, Aspen Properties			
2				
3	C:\AspenWorld 2004\Friday Paper\Heat_exchange.aprbkp			
4				
5	Global Units Set: English			
6				
7		WATER	BENZE-01	
8	viscosity	1.06182393	0.373087253	
9	thermalConductivity	0.83916422	0.075791638	
10	heatCapacity	17.9766545	32.82721459	
11	density	3.46063356	0.668678142	
12	molecularWeight	18.01528	78.11364	
13	pressure	14.7		
14	temperature	65	150	
15				

The spreadsheet interface includes a menu bar (File, Edit, View, Insert, Format, Tools, Data, Aspen Properties, Window, Help, Acrobat), a toolbar with various icons, and a status bar at the bottom showing "Ready". The active cell is B14, containing the value 65.

Export the Polymath Program to the Open Excel Book with a Single Keypress



The screenshot shows the Polymath 6.0 Professional Release software interface. The title bar reads "POLYMATH 6.0 Professional Release - [Ordinary Differential Equations Solver]". The menu bar includes File, Edit, Format, Program, Examples, Window, and Help. The "Program" menu is open, showing options: Solve (F5), Clear, Show Variables..., Export to Excel (F4), Order Equations, and Clear Comments. The "Export to Excel" option is highlighted. The main window displays a set of differential equations and initial conditions for a heat exchanger problem:

$$\begin{aligned}d(\text{TH2O})/d(x) &= \text{Dit} * (\text{TC6H6} - \text{TH2O}) / (\text{mH2O} * \text{CpH2O}) \\ \text{TH2O}(0) &= 6 \\ d(\text{TC6H6})/d(x) &= -\text{Ui} * 3.1416 * \text{Dit} * (\text{TC6H6} - \text{TH2O}) / (\text{mC6H6} * \text{CpC6H6}) \\ \text{TC6H6}(0) &= 150 \\ x(0) &= 0 \\ x(f) &= 70.5 \\ \text{Dit} &= 0.745 / 12 \\ \text{Dot} &= (.745 + 2 * .065) / 12 \\ \text{Dis} &= 1.610 / 12 \\ \text{Ds} &= \text{Dis} - \text{Dot} \\ \text{Dtlm} &= (\text{Dot} - \text{Dit}) / \ln(\text{Dot} / \text{Dit}) \\ \text{rot} &= \text{Dot} / 2 \\ \text{rit} &= \text{Dit} / 2 \\ \text{kt} &= 220\end{aligned}$$

The status bar at the bottom shows "Ln 20", "HeatExchangerConstantProperties.pol", "No Title", "11:03 PM", "10/14/2004", "CAPS", and "NUM".

The Polymath Problem is Automatically Exported to a new Excel Worksheet in the open Workbook.

Microsoft Excel - CutlipCocurr_CoolerAspenPropertiesSetup.xls

File Edit View Insert Format Tools Data Aspen Properties Window Help Acrobat

Type a question for help

F33

	A	B	C	D	E	F
1	POLYMATH DEQ Migration Document					
2		Variable	Value		Polymath Equation	Comments
3	Explicit Eqs	Dit	0.062083333		$Dit=0.745/12$	
4		Dot	0.072916667		$Dot=(.745 + 2 * .065) / 12$	
5		Dis	0.134166667		$Dis=1.610/12$	
6		Ds	0.06125		$Ds=Dis - Dot$	
7		Dtlm	0.06735486		$Dtlm=(Dot - Dit) / \ln(Dot / Dit)$	
8		rot	0.036458333		$rot=Dot/2$	
9		rit	0.031041667		$rit=Dit/2$	
10		kt	220		$kt=220$	
11		mC6H6	3000		$mC6H6=3000$	
12		mH2O	9000		$mH2O=3 * mC6H6$	
13		CpH2O	1		$CpH2O=1$	Water Heat Capacity
14		muH2O	2.5		$muH2O=2.5$	Water Viscosity
15		kH2O	0.35		$kH2O=0.35$	Water Thermoconductivity
16		rhoH2O	62.3		$rhoH2O=62.3$	Water Density
17		PrH2O	7.142857143		$PrH2O=CpH2O * muH2O / kH2O$	Water Prandtl Number
18		ReH2O	22134.33389		$ReH2O=Ds * mH2O / (3.1416 * (Dis ^ 2 - Dot ^ 2) / 4) /$	Water Reynolds Number
19		hH2O	863.5584507		$hH2O=kH2O * 0.023 * ReH2O ^ 0.8 * PrH2O ^ .4 / (Ds)$	Water Heat Transfer Coefficient
20		CpC6H6	0.435		$CpC6H6=0.435$	Benzene Heat Capacity
21		rhoC6H6	51.8		$rhoC6H6=51.8$	Benzene Density
22		muC6H6	0.88		$muC6H6=.88$	Benzene Viscosity
23		kC6H6	0.076		$kC6H6=0.076$	Benzene Thermoconductivity
24		PrC6H6	5.036842105		$PrC6H6=CpC6H6 * muC6H6 / kC6H6$	Benzene Prandtl Number
25		ReC6H6	69915.36978		$ReC6H6=Dit * mC6H6 / (3.1416 * Dit ^ 2 / 4) / muC6H6$	Benzene Reynolds Number
26		hC6H6	242.4587202		$hC6H6=kC6H6 * 0.023 * ReC6H6 ^ 0.8 * PrC6H6 ^ .4$	Benzene Heat Transfer Coefficient

PL1 Cocurrent-2 Sheet2 Sheet3

Ready

The Excel Spreadsheet is Ready for Solving Differential Equations

Microsoft Excel - CutlipCocurr_CoolerAspenPropertiesSetup.xls

File Edit View Insert Format Tools Data Aspen Properties Window Help Acrobat

Type a question for help

A39 fx

	A	B	C	D	E	
12		mH2O	9000		$mH2O=3 * mC6H6$	
13		CpH2O	1		$CpH2O=1$	Water Heat Capacit
14		muH2O	2.5		$muH2O=2.5$	Water Viscosity
15		kH2O	0.35		$kH2O=0.35$	Water Thermocond
16		rhoH2O	62.3		$rhoH2O=62.3$	Water Density
17		PrH2O	7.142857143		$PrH2O=CpH2O * muH2O / kH2O$	Water Prandtl Num.
18		ReH2O	22134.33389		$ReH2O=Ds * mH2O / (3.1416 * (Dis ^ 2 - Dot ^ 2) / 4) / muH2O$	Water Reynolds NU
19		hH2O	863.5584507		$hH2O=kH2O * 0.023 * ReH2O ^ 0.8 * PrH2O ^ .4 / (Ds * CpH2O)$	Water Heat Transfe
20		CpC6H6	0.435		$CpC6H6=0.435$	Benzene Heat Capa
21		rhoC6H6	51.8		$rhoC6H6=51.8$	Benzene Density
22		muC6H6	0.88		$muC6H6=.88$	Benzene Viscosity
23		kC6H6	0.076		$kC6H6=0.076$	Benzene Thermocond
24		PrC6H6	5.036842105		$PrC6H6=CpC6H6 * muC6H6 / kC6H6$	Benzene Prandtl Nu
25		ReC6H6	69915.36978		$ReC6H6=Dit * mC6H6 / (3.1416 * Dit ^ 2 / 4) / muC6H6$	Benzene Reynolds
26		hC6H6	343.4567292		$hC6H6=kC6H6 * 0.023 * ReC6H6 ^ 0.8 * PrC6H6 ^ .3 / (Dit * CpC6H6)$	Benzene Heat Tran
27		Ui	255.0875447		$Ui=1 / (1 / hC6H6 + ((rot - rit) * Dit) / (kt * Dtlm) + Dit / (hH2O * mH2O))$	Overall Heat Transf
28	Integration Vars	TH2O	65		$TH2O(0)=65$	
29		TC6H6	150		$TC6H6(0)=150$	
30	ODE Eqs	d(TH2O)/d(x)	0.469885004		$d(TH2O)/d(x) = Ui * 3.1416 * Dit * (TC6H6 - TH2O) / (mH2O * CpH2O)$	
31		d(TC6H6)/d(x)	-3.240586232		$d(TC6H6)/d(x) = -Ui * 3.1416 * Dit * (TC6H6 - TH2O) / (mC6H6 * CpC6H6)$	
32	Indep Var	x	0		$x(0)=0 ; x(f)=70.5$	
33						
34						

PL1 Cocurrent-2 Sheet2 Sheet3

Ready

The Polymath Solution Needs to be Copied into the Aspen Properties Worksheet

The screenshot shows a Microsoft Excel spreadsheet titled "CutlipCocurr_CoolerAspenPropertiesSetup.xls". The spreadsheet contains the following data:

	A	B	C	D	E
1	Problem 6.9 in Cutlip and Shacham, Part a, Benzene, Aspen Properties				
2					
3	C:\AspenWorld 2004\Friday Paper\Heat_exchange.aprbkp				
4					
5	Global Units Set: English				
6					
7		WATER	BENZE-01		
8	viscosity	1.06182393	0.373087253		
9	thermalConductivi	0.83916422	0.075791638		
10	heatCapacity	17.9766545	32.82721459		
11	density	3.46063356	0.668678142		
12	molecularWeight	18.01528	78.11364		
13	pressure	14.7			
14	temperature	65	150		
15					
16	POLYMATH DEQ Migration Document				
17		Variable	Value		Polymath Equation
18	Explicit Eqs	Dit	0.062083333		$Dit=0.745 / 12$
19		Dot	0.072916667		$Dot=(.745 + 2 * .065) / 12$
20		Dis	0.134166667		$Dis=1.610 / 12$
21		De	0.06125		$De=Dis - Dot$

The spreadsheet also shows a status bar at the bottom with "Ready" and sheet navigation options for "PL1", "Cocurrent-2", "Sheet2", and "Sheet3".

The Physical Property Information Is Copied into the Excel Problem Solution

C29		fx =B9			
	A	B	C	D	E
7		WATER	BENZE-01		
8	viscosity	1.0618239	0.37308725		
9	thermalConductiv	0.8391642	0.07579164		
10	heatCapacity	17.976655	32.8272146		
11	density	3.4606336	0.66867814		
12	molecularWeight	18.01528	78.11364		
13	pressure	14.7			
14					
15	POLYMATH DEQ Migration Document				
16		Variable	Value	Polymath Equation	
17	Explicit Eqs	Dit	0.062083333	$Dit=0.745 / 12$	
18		Dot	0.072916667	$Dot=(.745 + 2 * .065) / 12$	
19		Dis	0.134166667	$Dis=1.610 / 12$	
20		Ds	0.06125	$Ds=Dis - Dot$	
21		DtIm	0.06735486	$DtIm=(Dot - Dit) / \ln(Dot / Dit)$	
22		rot	0.036458333	$rot=Dot / 2$	
23		rit	0.031041667	$rit=Dit / 2$	
24		kt	220	$kt=220$	
25		mC6H6	3000	$mC6H6=3000$	
26		mH2O	9000	$mH2O=3 * mC6H6$	
27		CpH2O	0.997855961	$CpH2O=Aspen\ Properties$	
28		muH2O	2.568658264	$muH2O=Aspen\ Properties$	
29		kH2O	0.839164221	$kH2O=Aspen\ Properties$	
30		rhoH2O	62.34428265	$rhoH2O=Aspen\ Properties$	
31		PrH2O	3.054409252	$PrH2O=CpH2O * muH2O / kH2O$	

The Add-In (Ode_Solver) for Solving Differential Equations is Selected and Initialized

	A	B	C	D	E
23		rit	0.031041667		$rit = Dit / 2$
24		kt	220		$kt = 220$
25		mC6H6	3000		$mC6H6 = 3000$
26		mH2O	9000		$mH2O = 3 * mC6H6$
27		CpH2O	0.997855961		$CpH2O = \text{Aspen Properties}$
28		muH2O	2.568658264		$muH2O = \text{Aspen Properties}$
29		kH2O	0.839164221		$kH2O = \text{Aspen Properties}$
30		rhoH2O	62.34428265		$rhoH2O = \text{Aspen Properties}$
31		PrH2O	3.054409252		$PrH2O = CpH2O * muH2O / kH2O$
32		ReH2O	21542.70013		$ReH2O = rhoH2O * mH2O * v / muH2O$
33		hH2O	1442.380032		$hH2O = PrH2O * ReH2O$
34		CpC6H6	0.420249454		
35		rhoC6H6	52.23288364		
36		muC6H6	0.902535373		
37		kC6H6	0.075791638		
38		PrC6H6	5.004377922		
39		ReC6H6	68169.65543		
40		hC6H6	335.0055556		
41		Ui	277.9311371		
42	Integration Vars	TH2O	65		$TH2O(0) = 65$
43		TC6H6	150		$TC6H6(0) = 150$
44	ODE Eqs	d(TH2O)/d(x)	0.513064161		$d(TH2O)/d(x) = Ui * 3.1416 * Dit * (TC6H6 - TH2O) / (mH2O * CpH2O)$
45		d(TC6H6)/d(x)	-3.654715978		$d(TC6H6)/d(x) = -Ui * 3.1416 * Dit * (TC6H6 - TH2O) / (mC6H6 * CpC6H6)$
46	Indep Var	x	0		$x(0) = 0 ; x(f) = 70.5$
47					
48					

Polymath ODE

ODE initial values vector (Y)

ODE equations vector (Y')

Differential variable cell

Diffr variable final value

Show Report

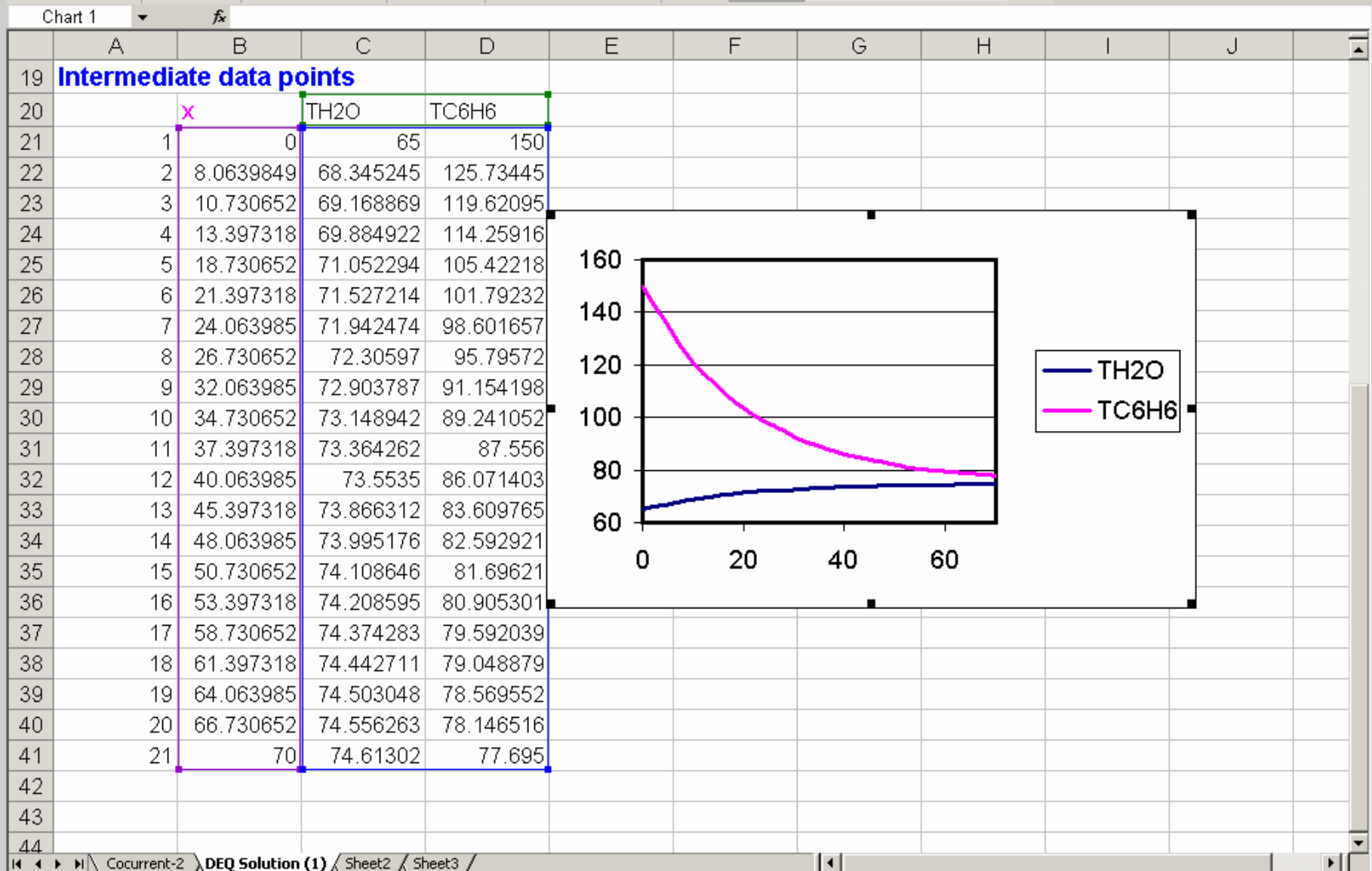
Intermediate Cells to Store:
 Data Points:

Exit Clear Adv. Help Solve

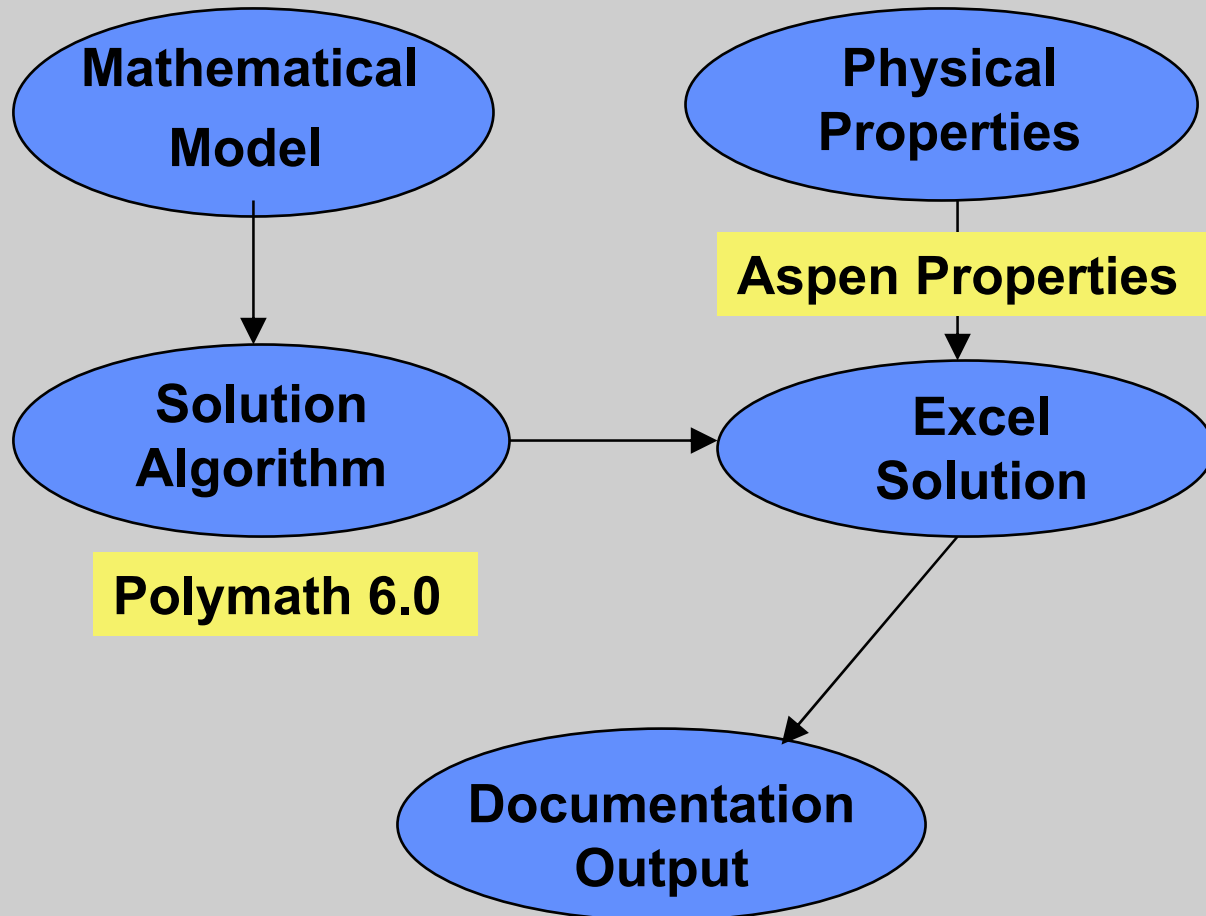
The Report of the Differential Equation Solution is Automatically Generated on a new Worksheet

POLYMATH Report DEQ						
Ordinary Differential Equations (RKF45).						
Calculated values of DEQ variables						
	Variable	Initial	Minimal	Maximal	Final	
1	x	0	0	70	70	
2	TH2O	65	65	74.61302	74.61302	
3	TC6H6	150	77.695	150	77.695	
Differential equations						
[1]	$d(C42)/d(C46) = (((C41 * 3.1416) * C17) * (C43 - C42)) / (C26 * C27)$					
[2]	$d(C43)/d(C46) = (0 - (((C41 * 3.1416) * C17) * (C43 - C42)) / (C25 * C34))$					
Independent variable						
Variable name: C46						
Initial value: 0						
Final value: 70						
Intermediate data points						
	x	TH2O	TC6H6			
1	0	65	150			
2	8.0639849	68.345245	125.73445			
3	10.730652	69.168869	119.62095			
4	13.397318	69.884922	114.25916			
5	18.730652	71.052294	105.42218			

A Graph can be Generated on the Report Worksheet



SUMMARY - A New Paradigm in Desktop Problem Solving Involving Polymath, Aspen Properties, and Excel Provides Advanced Problem Solutions in Excel



Engineers and technical personnel at their personal computers can now efficiently solve much more sophisticated problems on a personal computer while calling upon accurate physical property data, all within a friendly spreadsheet environment.

Software:

- Aspen Properties is a product of AspenTech
<http://www.aspentech.com/>
- Excel is a product of Microsoft Corporation
<http://www.microsoft.com/>
- Polymath is a product of Polymath Software
[http:// www.polymath-software.com](http://www.polymath-software.com)