Ch.E. 453 Fall 2007 Exam #3 Problem #1 11/30/2007

Title : Ethanol Pipeline Optimum Diameter and Cost

		=gpm * 30 minutes	gpm	=gpm / 7.481 / 60			
		gallons		ft3/sec	m3/sec		
Flow rate qf		90	3	0.006684	0.000189	0.000186	3.290556
Viscosity, cp	1.05	0.0007056	lb/ft-sec	=0.000672	0.00105	pascal-sec	
Density, Sp. Gravity	0.791	49.3584	lb/ft3	=62.4 * Sp.	790.65	kg/m3	

low viscosity fluid = assume turbulent; small flow = assume <1" diameter

assume turbulent <1" diameter = eqn. 9-77 =0.49 * qf^0.49 * den^0.14 * vis^0.027

	meters	inches			old 4th Edition Eqn's inches	
Diameter Opt.	0.0115	0.45	assume laminar >1" diameter = eqn. 9-78 =0.863 * qf^0.36 * vis^0.18		0.499	assume laminar >1" diamet
	0.0154	0.61	assume turbulent >1" diameter = eqn. 9-76 =0.363 * qf^0.45 * den^0.13 * vis^0.025		0.680	assume turbulent >1" diame
	0.0183	0.72	assume turbulent = eqn. 12-15 =0.363 * qf^0.45 * den^0.13	bad eqn in book		
	0.0155	**0.612**	inches =0.49 * (qf^0.49)*(den^0.14)*(cp^0.027)	=0.49*(G6^0.49)*(G8^0.14)*(G7^0.027)	**0.682**	assume turbulent <1" diame
0.000793	0.0109	0.43	assume laminar <1" diameter = eqn. 9-79 =1.33 * qf^0.40 * vis^0.20		0.490	assume laminar <1" diamet
0.031225						

Turbulent Assumption Reynolds Number Check

Diameter Opt.	**0.612**	inches	~ ID of nominal 1/2" diameter steel pipe, Schd. 40				
Velocity	3.28	ft/sec	=qf (ft3/sec) / (PI()* ((d/12)^2)/4)	1.00	m/sec		
Re = D V rho / mu < 2100			= (d inch/ 12 in./ft.)(V ft./sec.)(Den. Lb./ft^3) / Vis. Lb./ft.-sec.				
	11,681	greater than 2,100 thus turbulent assumption is valid				Alt.	
Actual Inside Diameter	**0.824**	inches	nominal 3/4" diameter steel pipe, Schd. 40	0.021	meters	**0.622**	nominal 1/2" diameter steel pipe, Schd. 40
Velocity	1.80	ft/sec	Table 14-2 recommends Velocity between 3 - 10 ft/sec	0.55	m/sec	3.17	Table 14-2 recommends Velocity between 3 - 10 ft/sec
	8,669	much greater than 2,100 thus turbulent assumption is valid				11,485	much greater than 2,100 thus turbulent assumption is v

Schedule Assumption Pressure Rating Check = Ch. 12 Eqn. 14: # = 1,000 * psi / 9000 or 1,000 * psi / 6500

			0.493	nominal 3/8" diameter steel pipe, Schd. 40
Schedule =	16.7	lap-welded 1000/9000 psi	5.04	Table 14-2 recommends Velocity between 3 - 10 ft/sec
	23.1	butt-welded 1000/6500 psi	14,490	much greater than 2,100 thus turbulent assumption is v
		less than 40 thus standard strength Sched. 40 is adequate		

		M&S 2002	M&S now					M&S 2002	M&S now	
	Fig.12-4 L	1102.5	1393				Fig.12-4 r	1102.5	1393	
0.02m=0.8"	**$ 45.0**	per meter	$56.86	= 3rd Qtr. 2007 cost per meter	$13.72	per foot	**$ 10.00**	per foot	$12.63	= 3rd Qtr. 2007 cost per foot
	105	feet	32	meters			32.004	meters	105	feet
			$ 1,819.66	= purchased cost for 3/4" pipe					$ 1,326.67	= purchased cost for 1/2" pipe
			$1,820.0	dollars					**$1,327.0**	dollars
							$ 9.00	per foot	$11.37	= 3rd Qtr. 2007 cost per foot
							32.004	meters	105	feet
									$ 1,194.00	= purchased cost for 3/8" pipe
									$1,194.0	dollars

Ch.E. 453 Fall 2005 Exam #3 Problem #2

Solution Master David C. Drown 11/30/2007

Biodiesel Transesterification Maximization EVOP

	Catalyst %	Excess EtOH	Temperature	Ave. Yield	Yield1	Yield2	Yield3	Yield4	Yield5	
1	1.00	94	100	90.2	88.8	90.3	89.6	92.1		discard lowest Yield = run 1
2	0.90	94	100	91.7	92.2	90.7	89.7	94		best run 2
3	0.95	100	100	90.7	90.9	89.3	93.4	89.3		run 3
4	0.95	97	120	90.9	90.7	90.5	90.9	91.6		run 4

0.87 **100** **113.3** discard lowest Yield = run 1

double the average of 3 best and subtract worst coordinates

=2*((B8+B9+B10)/3)-B7 =2*((D8+D9+D10)/3)-D7

=2*((C8+C9+C10)/3)-C7

=2*((0.90+0.95+0.95)/3)-1.0

=2*((94+100+97)/3)-94

=2*((100+100+120)/3)-100

Student Scores = 24

correct = 20 9

other -1 or 2 2 math errors

other -12 or more 13 did not average replicates, not EVOP

maximize -5

correct answers	correct method:
9	2

Maximum	Median	Average	Std. Dev.	Minimum
20.0	8.5	13.3	6.2	6.0

Ch.E. 453 Fall 2005 Exam #3 Problem #3

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GOLDEN SECTION SEARCH Reflux Ratio to Minimize Present Worth = 0

	Proposal C	Discounted C
0	$ (78)	$ (78)
1	$ 210	$ 60
2	$ 230	$ 18

2.528

$0.0025

PW =(-$78/(1+i)^0+210/(1+i)^1+230/(1+i)^2)

=(B8/(1+$A$16)^A8+B9/(1+$A$16)^A9+B10/(1+$A$16)^A10)

Golden Ratio = 0.381966

Lower Limit	Upper Limit	Length	Dist.		Point	Cost		at Lower & Upper LIMITS: P W
0.05	3	2.95	1.1268	lower	1.1767997	$ 67.01	< HIGH = Discard	$ 330.62
iteration #1				upper	1.8732003	$ 22.95		$ (11.13)
1.1768	3	1.8232003	0.696401	lower	1.87320023	$ 22.95	< HIGH = Discard	
iteration #2				upper	2.30359947	$ 6.64		
1.8732	3	1.126799774	0.430399	lower	2.30359943	$ 6.64	< HIGH = Discard	
iteration #3				upper	2.5696008	$ 1.12		
2.303599	3	0.696400572	0.266001	lower	2.56960077	$ 1.12		$ 16.45
iteration #4				upper	2.73399866	$ 5.26	> HIGH = Discard	
2.303599	2.733999	0.430399231	0.164398	lower	2.4679973	$ 1.68	< HIGH = Discard	
iteration #5				upper	2.56960079	$ 1.12		
2.467997	2.733999	0.266001358	0.101603	lower	2.56960078	$ 1.12	BEST POINT	
iteration #6				upper	2.63239518	$ 2.76	> HIGH = Discard	
2.467997	2.632395	0.164397883	0.062794					

Recommended Discounted Cash Flow ROI between

247% 263%

257.0% BEST POINT

IRR result= 252.809% $ 0.000000 Very BEST POINT

Golden Macro Best= 2.5282571 $ 0.0046