Homework Problem #4		Copy first part from Problem #3									
Chem Eng 310											
	As Rec'd Basi	Dry Basis	Dry, Ash-Free	Moles/100 g	Product	Heat of For	Stoich. Coeff.	Heat of Products			
Moist.	**28.09**					(kcal/mol)		(kcal/100 g)			
Ash	**6.31**	8.77									
C		**68.43**	75.01	6.25	CO2	-94.05	1.00	-587.92			
H		**4.88**	5.35	5.35	H2O	-68.32	2.00	-182.73			
N		**1.03**	1.13	0.08	N2	0.00	2.00	0.00			
S		**0.63**	0.69	0.02	SO2	-70.96	1.00	-1.53			
O		16.26	**17.82**	1.11	O2	0.00	2.00	0.00			
Heating Value (Btu/lb)	**-8426.00**	-11717.42	**-12844.51**								
Heating Value (cal/g)	-4680.64	-6509.03	**-7135.13**				Sum =	-772.18			
Heat of formation = Heat of products - Heat of Combustion											
Heat of products =	-772.18	kcal/100 g =	-7721.81	cal/g							
Heat of combustion =			-7135.13	cal/g							
Heat of formation of coal =			**-586.68**	**cal/g**	-2.45	kJ/g					
					-245.47	kJ/100g or kJ/mol					
(a) Flow rate required											
Flow rate (lbs/hr as rec'd)	50.00						2.31				
Flow rate of moisture	14.05	lbs/hr	6376.43	g/hr	354.25	gmole moist/hr					
Flow rate of ash	3.16	lbs/hr									
Flow rate of daf coal	32.8	lbs/hr				O2 needed		gmoles prod/hr		Mole frac	
			930.85	gmoles C /hr	1.00	930.85		930.85	gmoles CO2/h	0.12567	
			796.59	gmoles H /hr	0.25	199.15		398.30	gmoles H2O/h	0.10159	
			12.01	gmoles N /hr	0.00	0.00		6.00	gmoles N2/hr	0.00081	
			3.21	gmoles S /hr	1.00	3.21		3.21	gmoles SO2/h	0.00043	
			165.84	gmoles O /hr	-0.50	-82.92		354.25	gmoles H2O/hr from moist		
			Stoichiometric O2=		sum	1050.29	gmoles/hr				
				Now guess O2 flow rate		1420.66	gmoles/hr of O2	370.37	gmoles O2/hr	0.05000	(want .05)
				Ratio =	1.35263	6765.06	gmoles/hr of air	5344.40	gmoles N2/hr	0.72150	
						196186.78	g/hr of air	7407.38	total gmoles/h	1.00000	
						432.13	**lbs/hr of air**				
(b) Heat removal rate	Tinp (K) =	298		Q = in - out = - (out - in) = - (delH_rxn + DelH_prod_298 to T_final)							
	Tout (K) =	1373									
Combustion Heat	-1.06E+08	cal/hr	(at 298 K)								
Heat of Vaporization	6.90E+06	cal/hr	(at 373 K)	DelH_vap=	9.171	kcal/gmol	sensible heat				
				Integral			moles*integral				
Heat Capacity Data	a	bT	cT^2	298	373	1373					

CO2	6.214	1.04E-02	-3.55E-06			1.30E+04	1.21E+07	cal/hr			
H2O (l)	18				1350		1.02E+06				
H2O	7.256	2.30E-03	2.83E-07			9.50E+03	7.15E+06				
N2	6.524	1.25E-03	-1.00E-09			8.14E+03	4.35E+07				
SO2	7.116	9.51E-03	3.51E-06			1.92E+04	6.17E+04				
O2	6.148	3.10E-03	-9.23E-07			8.61E+03	3.19E+06				
Integrate gas products	6.70E+07	cal/hr				sum=	6.70E+07				
Ash (2.1 cal/g/K)	3.23E+06	cal/hr									
Total Heat Out + Vap	7.72E+07	cal/hr					7.72E+07				
Heat Removal	2.91E+07	cal/hr	Fraction of heat removed=		-27%						
	1.16E+05	**Btu/hr**									
	3.39E+01	kW									
(c) Two stages											
Stoichiometric oxygen =	1050.29	moles/hr of O2	(from above)								
S.R. = 0.6	630.18	moles O2/hr									
	3000.84	moles air/hr									
	87024.32	g air/hr									
	191.68	**lb air/hr**									
S.R. = 1.2	Total required		**Added in Second Stage**								
	1260.35	moles O2/hr	630.18								
	6001.68	moles air/hr	3000.84								
	174048.63	g air/hr	87024.32								
	383.37	**lb air/hr**	**191.68**								