Validation of Hysys Depressuring Utility

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Introduction

As explained in note "Set depressuring model dimensions to get more accurate results", Hysys depressuring model is very simple model compared to the actual system which comprises of different vessels and pipes in different conditions and orientations. It was also made clear that in spite of all efforts in preparing proper inputs for Hysys model, the applicability of results gets limited by the nature of model. In view of this, the next question is "how accurate the results of such a simple model would be in comparison to experimental data". There is not much data available from real plants during depressuring but there are some laboratory tests performed and published by Chemical Engineering Department of Imperial College to demonstrate the validity of their software called "Blowdown". This note uses this article[1] and some other references[2] to investigate the validity of Hysys depressuring utility. In absence of actual data Blowdown software's results are assumed to be as good as test data.

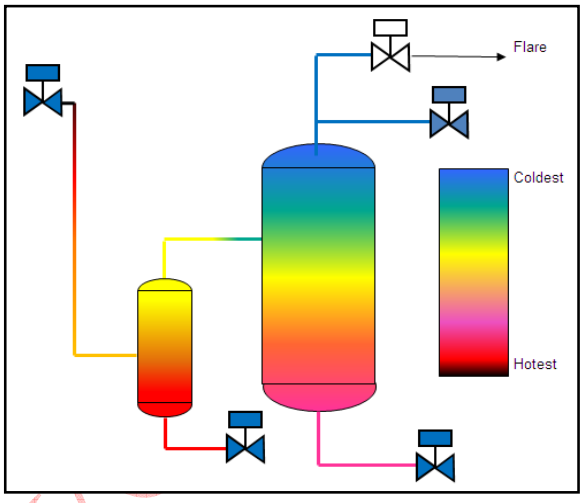

Figure 1 – Temperature profile during depressuring

Reference should be made to technical note "Effect of different parameters on depressuring calculation results".

Case study

An extensive study was carried out to check the validity of Hysys depressuring utility. Hysys results were compared with experimental data with respect to following aspects:

1. The minimum temperature value (shown in Table 1)
2. The trend of temperature changes versus time (temperature profile)
3. The time (pressure) in which minimum temperature takes place

Table 1 – Comparison between Hysys results and experimental data

Item No	Case Description	Min. Gas Temp. (K)		Min. Metal Temp. in contact with Gas, (K)		Min. Liquid Temp. (K)		Min. Metal Temp. in contact with Liquid, (K)	
		HYSYS	EXP.	HYSYS	EXP.	HYSYS	EXP.	HYSYS	EXP.
1	Reference 1 – Case I 1	190.5	190	286.9	281	-	-	-	-
2	Ref. 1 – Scrubber Case 1	210.6	210	272.0	264	-	-	-	-
3	Reference 1 – Case S 9	248.3	250	296.8	290	245.6	242.5	249.1	250
4	Reference 1 – Case S 12	237.3	242	284.1	283	236.4	247	248.9	249
5	Ref. 1 – Scrubber Case 2	212.2	214	272.4	264	212.2	232	224.5	237
6	Reference 1 – Separator	223.9	222	280.9	NA	223.9	265	273.7	267
7	Reference 2 – V-2501	213.8	215	269.3	264	213.8	245	229.3	250
8	Reference 2 – C-5101	219.6	223.2	270.4	263	219.6	239	231.3	242
9	Reference 2 – V-2101	222.7	222	273.2	265	222.7	257	243.7	261

Note:

In above table, items 1 and 2 are gas filled vessels. Item 3 to 5 are gas filled vessel with liquid formation (condensation) during depressurization. Items 6 to 9 are initially two phase systems.

Comparing Hysys results and experimental data, the following conclusions can be outlined:

- Being single hold up model, Hysys is unable to calculate the temperature of different parts of system with respect to their distance from depressuring valve and thickness.
- Hysys accurately predicts the temperature of metal in contact with gas (minimum value, shape and the time in which minimum temperature takes place).
- Hysys predicts minimum gas temperature accurately but the shape of temperature profile and the time in which minimum temperature takes place does not match with experiments.
- Hysys predicts minimum metal in contact in with liquid accurately but the shape of temperature profile and the time in which minimum temperature takes place does not match with experiments.
- Hysys does not correctly predict the minimum liquid temperature, the shape of temperature profile and the time in which minimum temperature takes place.

The result of this study for three type of systems has been summarized in Table 2.

Table 2 –Hysys results validity

System Description	Temperature			
	Gas	Liquid	Metal in contact with gas	Metal in contact with liquid
Gas filled	Very good	-	Very good	-
Gas filled with liquid condensation	Good	Not acceptable	Good	Good
Initially two phase	Good	Not acceptable	Good	Acceptable *

* often much lower than experimental data (highly conservative)

Conclusion

Considering above categories, it can be concluded that Hysys is generally a valid tool as it correctly predicts the temperature of gas, metal in contact with gas and metal in contact with liquid which is normally used for specifying system minimum design temperature and material selection.

Since liquid temperature is not normally used for specifying MDMT for any of the systems mentioned in table 2, there is no major concern if hysys results deviate from experimental values.

Reference

1) M.A. Haque, S.M. Richardson, G. Seville, G. Chamberlain, L. Shirvill, “Blowdown of pressure vessels, part II, “Experimental validation of computer model and case studies”, Department of Chemical Engineering, Imperial College, Trans IChemE, Vol. 70, Part B, Feb. 1992

2) S.M. Richardson, G. Seville, “Blowdown of Harweel system 1-3”, Department of Chemical Engineering & Chemical Technology, Imperial College, July 2006

Contact

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