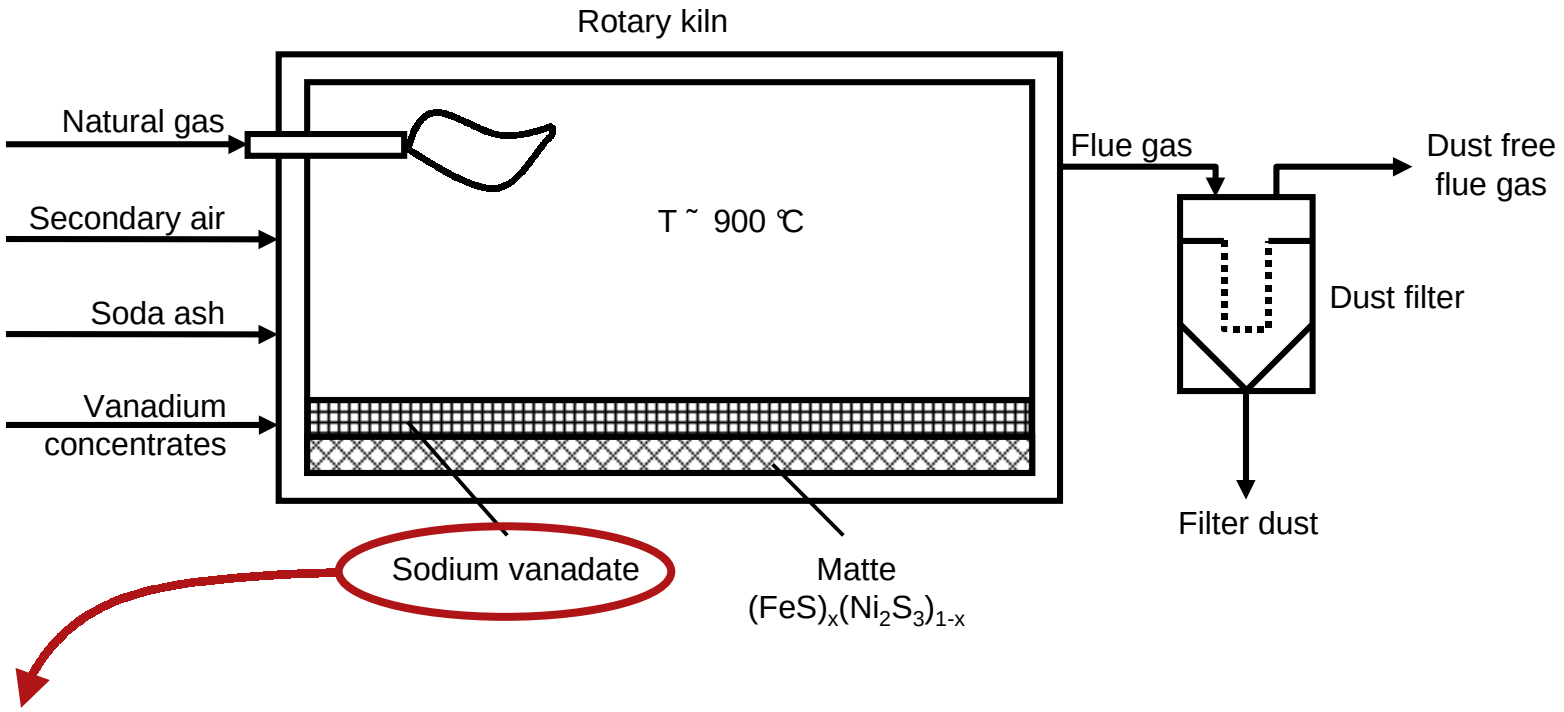
Modelling of the Vanadium Production from Petroleum Residues with FactSage

A. Bimüller, FES, Rednitzhembach

9th GTT-Workshop, 2007
Herzogenrath, Germany

Processing of vanadium concentrates



- Sodium meta-vanadate: $(Na_2O)(V_2O_5) = Na_2V_2O_6 = 2\ NaVO_3$
- Sodium pyro-vanadate: $(Na_2O)_2(V_2O_5) = Na_4V_2O_7$
- Sodium ortho-vanadate: $(Na_2O)_3(V_2O_5) = Na_6V_2O_8 = 2\ Na_3VO_4$

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Important chemical reactions

Formation of sodium vanadate and matte

$$4\ VOSO_4 + 4\ Na_2CO_3 \ ?\ 2\ Na_4V_2O_7 + 4\ SO_2 + 4\ CO_2 + O_2$$

$$3\ NiSO_4 + Fe_2(SO_4)_3 + 10\ C \ ?\ Ni_3S_2 + 2\ FeS + 2\ SO_2 + 10\ CO_2$$

Prevention of SO_X

$$4\ VOSO_4 + 8\ Na_2CO_3 + O_2 \ ?\ 2\ Na_4V_2O_7 + 4\ Na_2SO_4 + 8\ CO_2$$

$$3\ NiSO_4 + Fe_2(SO_4)_3 + 2\ Na_2CO_3 + 9\ C \ ?\ Ni_3S_2 + 2\ FeS + 2\ Na_2SO_4 + 10\ CO_2$$

Questions to be answered:

- How much soda ash is required to form the sodium vanadate and to avoid the formation of SO_X in the flue gas?
- Under which conditions do the sodium vanadate and the matte form simultaneously?

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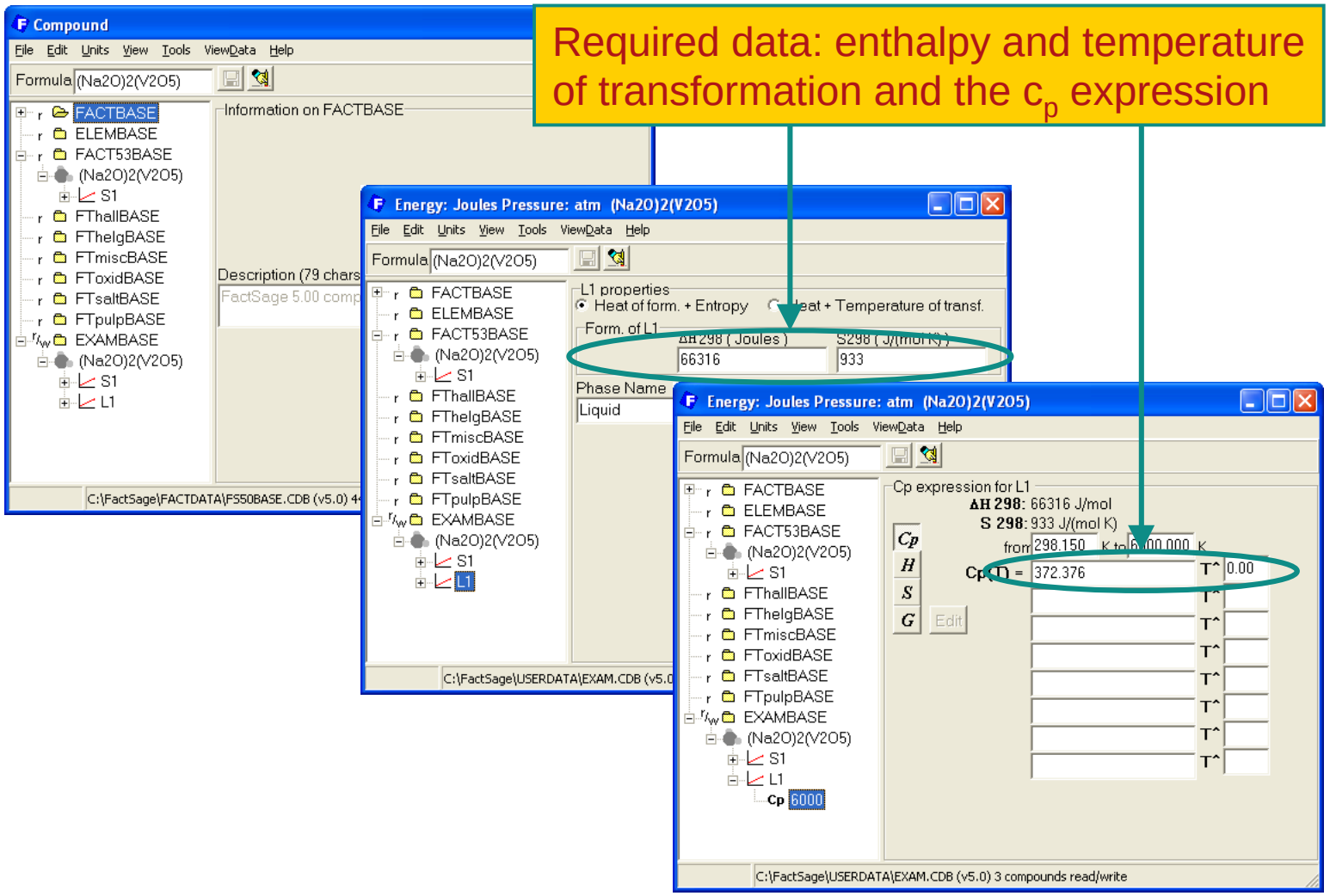
Matching the FactSage database



Source of thermochemical data

Compound	Formula	Melting point [K]	c_p (liq) [J/(mole·K)]
Sodium meta-vanadat	$(Na_2O)(V_2O_5)$ = 2 $NaVO_3$	903	284.512
Sodium pyro-vanadate	$(Na_2O)_2(V_2O_5)$ = $Na_4V_2O_7$	933	372.376
Sodium ortho-vanadate	$(Na_2O)_3(V_2O_5)$ = 2 Na_3VO_4	1139	358.140

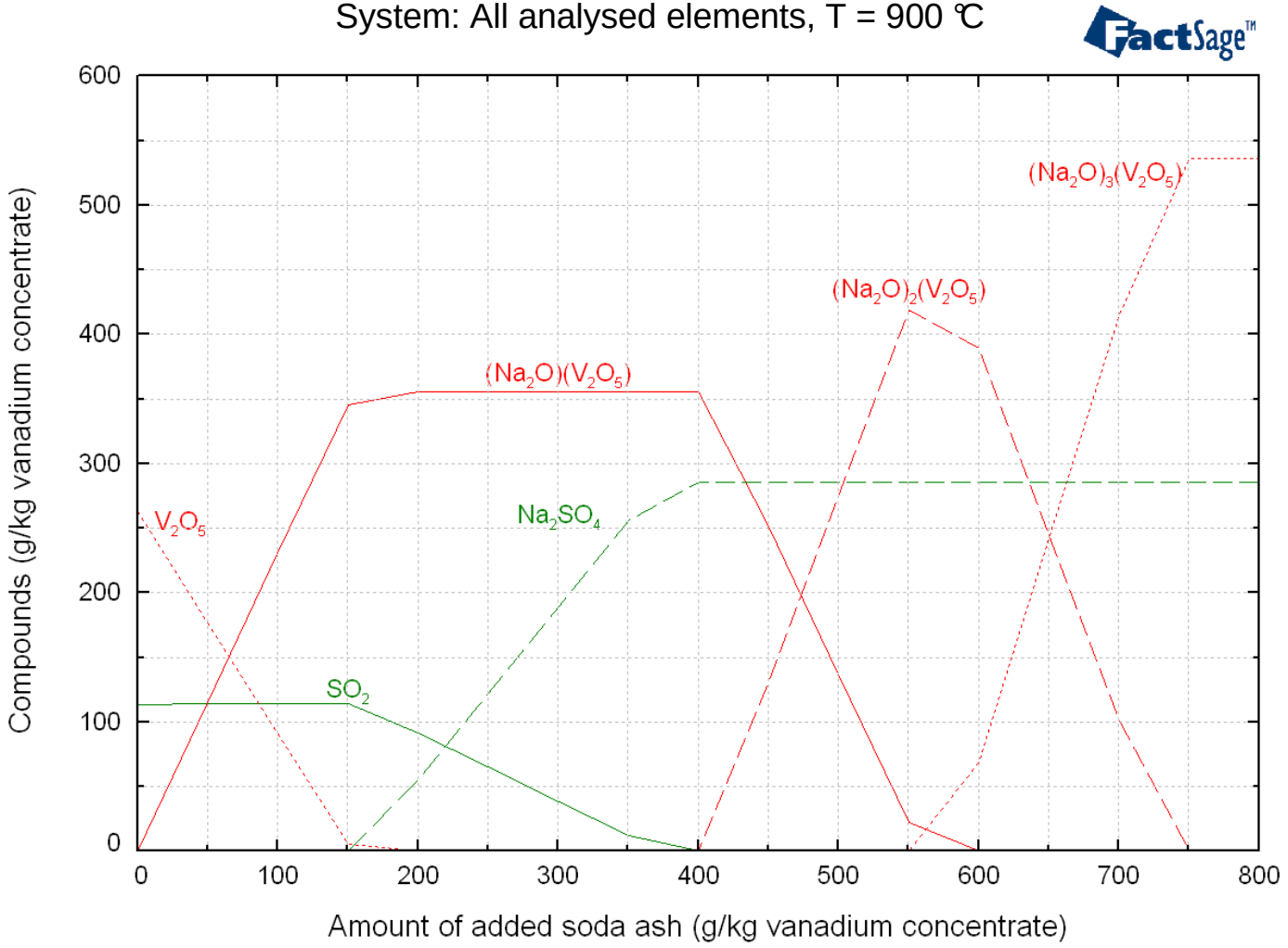
Barin I. (1995): Thermochemical Data of Pure Substances, Vol. II, 3rd edition, VHC Weinheim

estimated

Weast R.C. et al. (1984-1985): CRC Handbook of Chemistry and Physics, 65th edition, CRC Press, Inc., Boca Raton, Florida

Formation of sodium vanadate and SO_2 at 900 ℃

System: All analysed elements, T = 900 ℃



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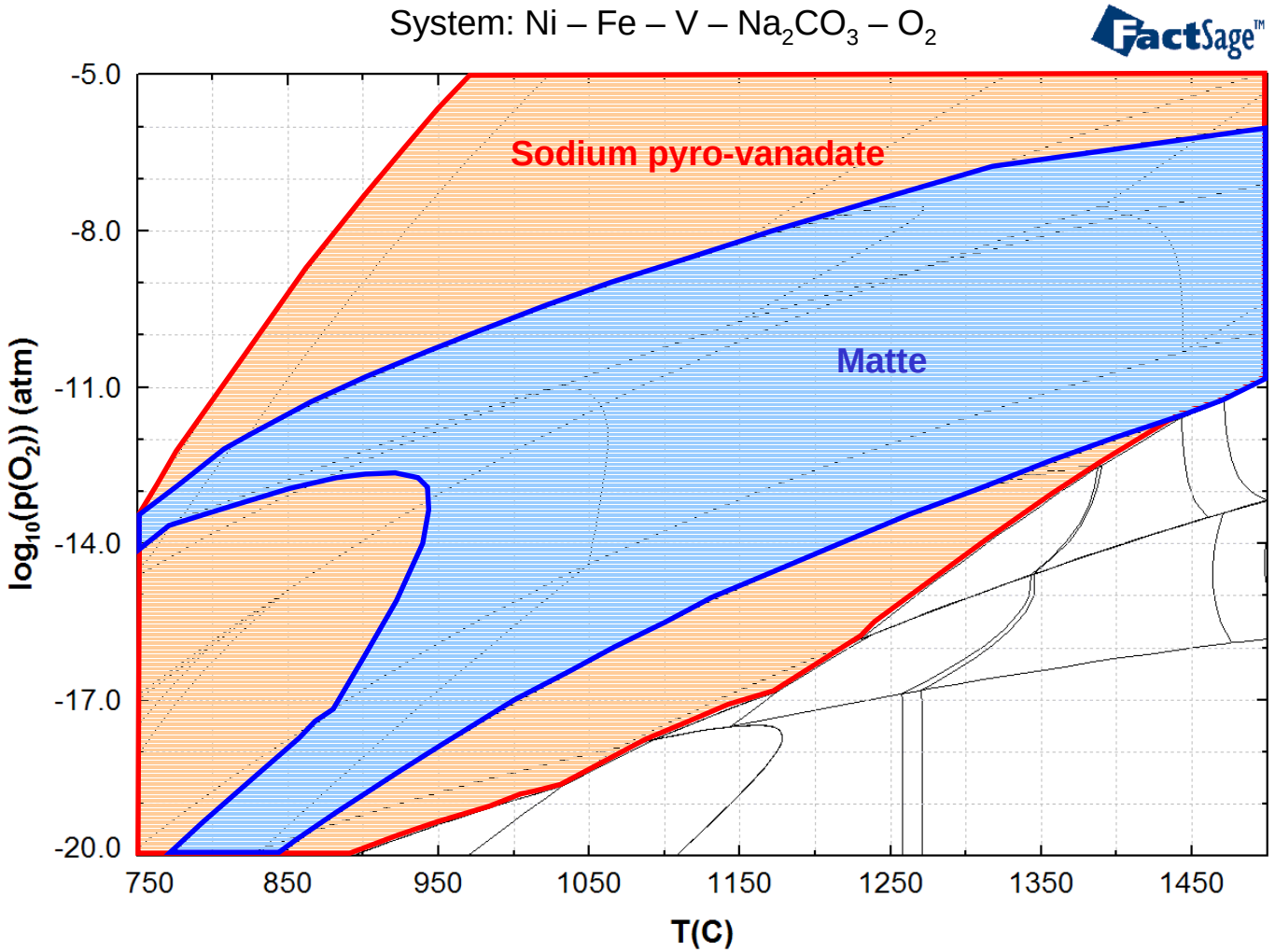
Formation of sodium vanadate and matte



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Summary

- Successful integration of a new data base to calculate liquid sodium vanadate
- Equilib module: Required amount of soda
- Phase Diagram module: predominance area of sodium vanadate and matte

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Thank you for your attention