The Murmur of Mr. Methyl Alcohol

I am Mr. Methyl Alcohol, who has diverse kinds in my own group deprived from organic matters that mainly support the ecosystem on the earth. Needless to say that my position today is contributed to the relationship with human beings, however, now I (methyl alcohol) also contribute to the human life in the every aspect such as clothes, foods, houses, etc. I believe I surely become one of the very important material and now used all over the world.

It has been long time for me, Mr. Methyl Alcohol, to play an important role in the atmosphere heat treatment mainly for metal. From my standpoint as methyl alcohol, I would like to discuss the better use of methyl alcohol with advancing of technology so as to find the new industrial stage that I might be able to play more important role in the future.

Basically I (methyl alcohol) am composed of H_2, C and O_2. These three elements combine together and stay as a one of compounds, Methyl alcohol. However, if methyl alcohol is excessively heated up, that is, when heat energy become higher than the combining energy, the combined elements would be parted. Three energy factors (temperature, time and pressure) will all effect on the chemical reaction, but especially when the heat energy become larger than others, these three elements will part and start independently behaving. However, when the less heat energy is given, an element may remain itself and some chemical compounds or mixtures of two elements or of three elements are newly produced. It is obvious that temperature, time and pressure significantly effect on composition and quantity of the new-produced materials. But also methyl alcohol will fundamentally assist to decompose and produce the compounds. Therefore I wish (as methyl alcohol) to be properly and carefully treated and hope that the most practical usage should be searched and developed.

For metal heat treatment, it is the most ideal that 100% of methyl alcohol is decomposed into CO and H_2. Sometimes the impurities are contained in methyl alcohol, which may disturb decomposing into CO and H_2 properly. However, the amount of impurities on industrial average would be so small that it causes no problem. The incomplete decomposition will depend mainly on the thermal process.

While heating up a certain material, two factors, time and temperature, will effect the result. Even if the best temperature, time and pressure are set in advance for the ideal thermal decomposition, it may not be completed before reaching to the set temperature. Incomplete decomposition results in forming CO_2, H_2O and free oxygen instead of forming CO and H_2. The formation of CO_2, H_2O and free oxygen is to be seen in the low temperature zone before reaching to the ideal temperature. Once those are formed, usually secondary reaction of C and H_2O will not take place even in the higher temperature zone to follow. In other words, methyl alcohol will be ideally decomposed for metal heat treatment only when the temperature is raised quickly enough. However, the longer it takes time to heat up to the required temperature, the more incomplete decomposition is caused. [Fig.1, Table 1, Table 2]

The intensive carburization can be performed when the atmospheric furnace is filled with the gas produced from completely decomposed methyl alcohol. In that case, the capacity ratio of H_2 and CO is 2 : 1. This ratio may be changed if the large amount of CO_2, H_2O and C are produced from incompletely decomposition. However, it can be ignored when that amount is quite small. When the gas, produced from the ideal complete decomposition, is transferred into carburizing chamber, it will perform hyper-eutectoid carburization there in equilibrating the temperature and pressure. The small amount of CO_2 will lower the carbon equilibrium if it is too high. In case that 98 % or more of methyl alcohol is completely decomposed into H_2 and CO (capacity ratio 2:1), the carbon equilibrium will be quite high. [Table 2] For steel heat treatment, the carbon equilibrium must be corrected by dilution according to the steel type and carburizing condition. To dilute the gas, hot air or exothermic generating gas may be added.[Fig.2,Fig.3]

When carbon, sub-generated by incomplete decomposition, is solidified to be out of gas zone, partial pressure of moisture and carbonic acid gas will increase while the carbon equilibrium will decrease. To correct gas for carburization, hydro carbon or fortified alcohol is added to urge secondary reaction. However, this correction is required only when methyl alcohol did not completely decompose. Conversely, if the complete decomposition is achieved without sub-generating moisture and carbon, the carbon equilibrium may be too high, and needs to be lowered according to the various purposes. In this case, there should be the carbon-diluting gas circuit provided, instead of providing the carbon-enriched gas circuit. As formerly mentioned, hot air will be applied for dilution. So the oxygen in the air will oxidize

small amount of CO to lower the equilibrium of carbon. And then N_2 in the air will slightly lower the partial pressure of CO.

When exothermic generating gas is used to dilute, then carbonic acid gas would directly work to lower the carbon equilibrium. The gas generated by decomposing methyl alcohol usually provides high carburizing power [Fig.4] since it contains larger amount of CO than endothermic generating gas generated by mixing hydro carbon and air. However, because of containing large amount of H_2, its specific gravity is low and the gas-tightness keeping furnace pressure is also low. For this reason, the carburizing chamber should be carefully designed to prevent the air from incoming and keep the purity of atmosphere.

In this age, I (methyl alcohol) can be delivered to any place on the earth through convenient transportation means across the seven seas. Even in the remote place, I can be delivered in drum can or by tank truck. In truck or drum, I am simply "methyl alcohol" form though, I will be able to turn into an excellent gas-carburizing agent when thermally decomposed. Before shipment, I was once H_2 and CO extracted from petroleum. So I (methyl alcohol) am very pleased to be useful by being decomposed into H_2 and CO again. The targeted value in order to use methyl alcohol properly is as follows : There must be 32 % or more of CO, and CH_4 + CO_2 in total must be less than 1 % after first decomposition. I hope that my best usage would be known widely and wish to contribute more to industry.

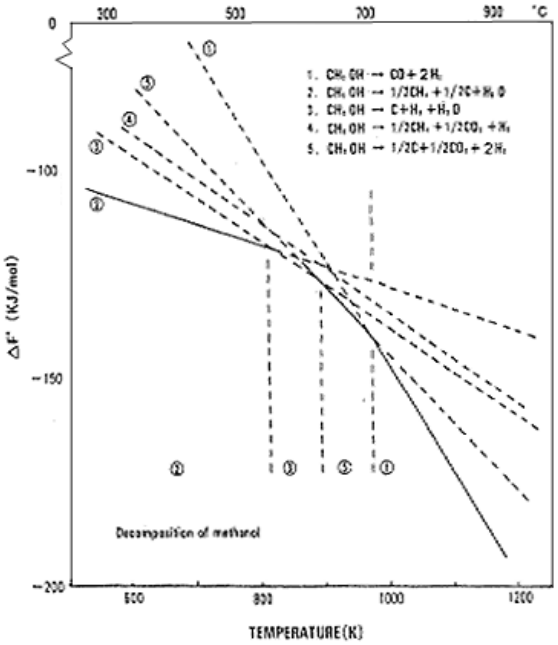

Fig. 1 Decomposition of Methyl Alcohol

(1) J. Heat Treating, **5**, 2, p.107 (1988).

Table 1 Methyl alcohol decomposition gas (Calculated value)

Decomposition Rate	Product (V%) (C = when it is precipitated by 1 mol. of Methyl alcohol)						Carbon equilibrium [C%]					
	CO	CO_2	H_2	H_2O	CH_4	C *1	800℃	850℃	900℃	950℃	1000℃	1050℃
100 %	33.3		66.7				1.36	1.37	1.38	1.40	1.43	1.46
98 %	32.89	0.17	66.11	0.34	0.34	0.5	1.18	1.05	0.85	0.66	0.49	0.35
96 %	32.43	0.34	65.54	0.68	0.68	1.0	1.00	0.82	0.61	0.43	0.29	0.20
94 %	31.97	0.51	64.97	1.02	1.02	1.5	0.87	0.67	0.47	0.31	0.21	0.13
92 %	31.51	0.68	64.38	1.37	1.37	2.0	0.76	0.56	0.38	0.24	0.16	0.10

The short of percentage is what can not be completely decomposed. $0.5CH_4 + 0.25CO_2 + 0.25C + 0.5H_2O + 0.5H_2$

*1 C is out of gas phase and gives no effect on secondary decomposition.

Table2 Decomposition rate of methyl alcohol for industrial use (Actual measured value)

Composition / Temperature (℃)	CH4 (%)	CO2 (%)	Carbon equilibrium (C%)				
			880℃	930℃	980℃	1030℃	1080℃
880	0.873	0.493	1.00	0.84	0.65	0.49	0.28
915	0.670	0.298	1.10	1.06	0.93	0.77	0.61
930	0.600	0.242	1.21	1.14	1.03	0.90	0.82
955	0.503	0.173	1.28	1.23	1.17	1.09	1.00

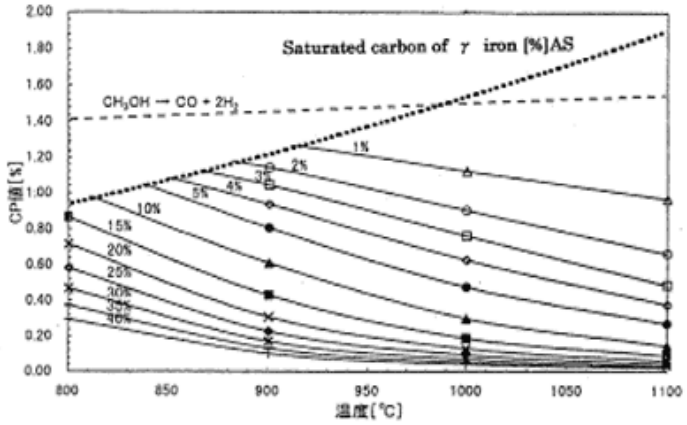

Fig. 2 When decomposition gas of methyl alcohol (930℃) is diluted by DX gas.

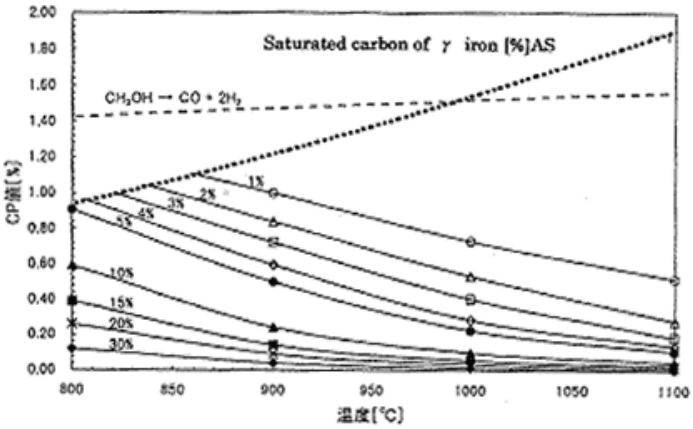

Fig. 3 When decomposition gas of methyl alcohol (930℃) is diluted by air.

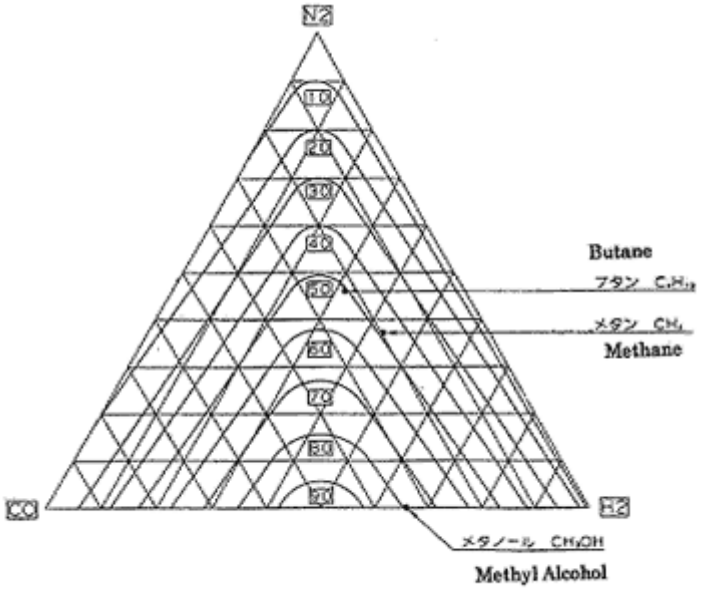

Fig. 4 Uniform curve of Carburizing power