Influence of belt furnace on engine valve heat treatment

What is an engine valve?

Fig 1 shows typical engine valves. Engine valves are essential parts for engine functioning. They are located in the cylinder head and can be classified into intake valves and exhaust valves. The intake valves bring in air/fuel into chamber for combustion and the exhaust valves let exhaust out after burning. The open and close of valves are decided by the cylinder piston positions. A detailed explanation by Marshall Brain on how engine works can be found at http://auto.howstuffworks.com/engine4.htm.

Fig 1. Typical engine valves (Courtesy of online picture http://www.plxsport.com/atv-parts-valvetrain-wiseco-titanium-intake-valve-suzuki-ltr-450?att_id=0)

Engine valves heat treatment description

The working conditions of engine valves are severe. Doug Kaufman states that intake valves typically run at the range of 800F—1000F (427C-538C) while exhaust valves typically run at 1200F—1450F (649C-788C), due to the temperature difference of intake gas and exhaust. Besides high temperature, valve also experiences cyclic loading. A valve can open and close dozens of times per second.

Because of the high working temperature and strength required in such conditions, heat resistant steels are often used. Besides proper material selection, proper heat treatment is essential in manufacturing high performance engine valves. It is vital to create the desired properties like strength, wear resistance, toughness, fatigue strength, hardness and microstructure.

Normal heat treating methods include annealing, normalizing, tempering and hardening. To decide a specific heat treatment process, alloy phase diagram (Fig. 2) is the fundamental tool.

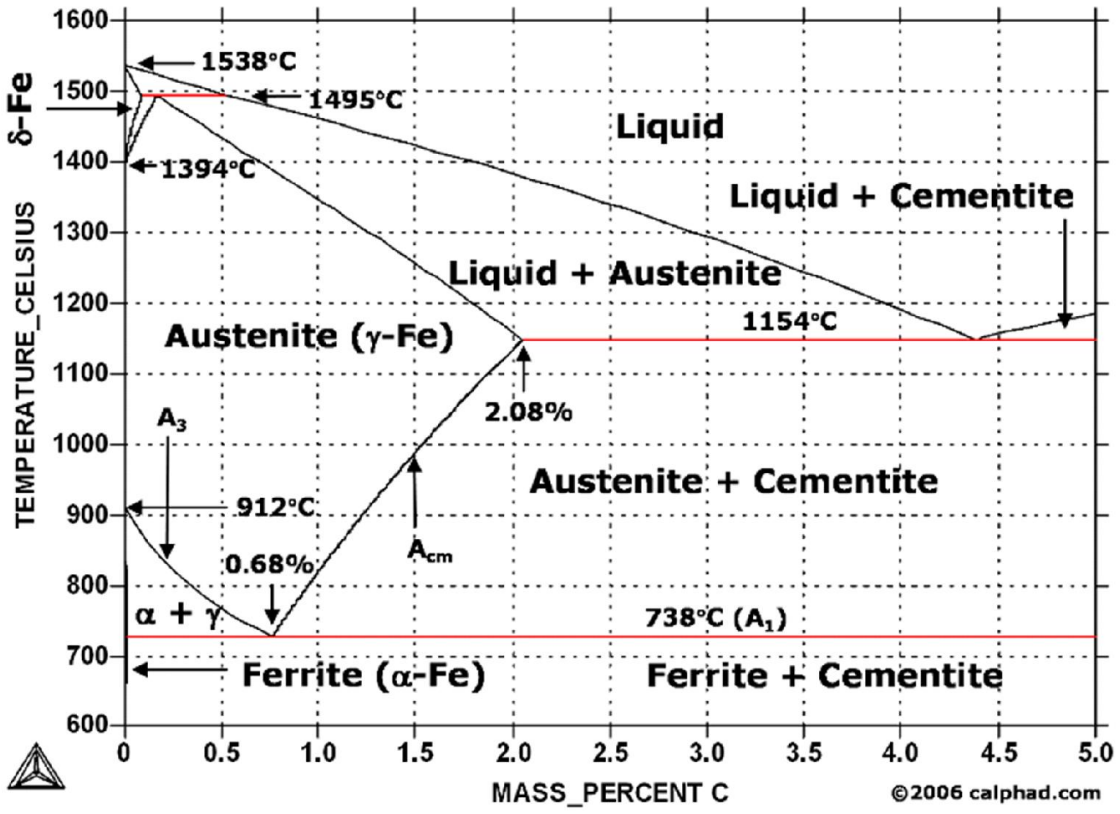

Fig 2.Fe-C phase diagram (Courtesy of online source http://www.calphad.com/iron-carbon.html)

A typical heat treating process for VAZ PASSENGER CARS engine valves was published in. Metallovedenie i Termicheskaya Obrabotka Metallov, No. 10, pp. 6- 9, 1996. Several major steps in the heat treatment process for inlet valves includes:

1) Preliminary heat treatment, annealing to around 700C for 3—4 hours to obtain Spheroidized pearlite with certain hardness.
2) Stabilizing annealing. Hold 2-3 hours at 600 - 620°C to release stress and eliminate warping issues that might occurred in other process

For outlet valves the heat treatment process is a little different because of the quality requirement difference between inlet and outlet valves.

HSK fast firing furnace for engine valve heat treatment

The HSK series fast fire furnace heats from ambient to 1050C in approximately 40 minutes and is designed to sustain continuous on/off heating and cooling cycles resulting from alternating periods of production and non-use. It features an ultra-clean low-mass refractory heating chamber equipped with FEC (Fully Enclosed Coil) heaters formed into ceramic insulation panels.

With the use of advanced insulation materials, lower thermal capacity enables the furnace to warm up and cool down very quickly and lose less heat to the environment.

To prevent valves from falling off the belt, a hearth plate with walls can be incorporated within the furnace. The belt would travel through the furnace on a metal hearth plate with side walls, which would prevent products from falling off the belt.

Appendix I shows the brief technical details of a HSK fast firing furnace.

APPENDIX I

Technical Specification for Model HSK Series Conveyor Furnace

Main Characteristics

Specification	HSK2505-0611
Rated Temperature	1,050 deg. C
Belt Width	250mm/10"
Above Belt Clearance	50mm/2.0"

Specification	HSK2505-0611
Heating Length	2700 mm/106.3"
Cooling Length	1240 mm/48.8"
Control Zones	6
Conveyor Speed	30-200mm(1.2"-8")/min
Overall System Width	1200 mm/47.2"
Overall System Length	6905 mm/272"
Overall System Height	1350mm/53"
Typical Temp. Uniformity	+/-3 deg. C
Net Weight	1,200kg
Power	AC 220-480V, 3 phase, 5 wire, 50/60 Hz, 42 kW Power draw at normal operating conditions: <15 kW

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