TRIP Steel for Automobile Industry in Vietnam

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Abstract—When Vietnam joined the World Trade Organization (WTO), we made a non-discriminatory commitment between home-made goods and imported goods, so the great protection of domestic manufacturing enterprises is not can exist. Special consumption tax is only a historical period and will have to be adjusted, as this time transport infrastructure is still poor, people's living standards are not high. Particularly for domestically produced cars, it is not much affected by import tax, but still subject to SCT by the number of seats and cylinder capacity in accordance with the Law on Special Consumption Tax. As for value added tax (VAT), we should not mention much because most consumer products in Vietnam apply a VAT rate of 10%. The application of tariffs aims to encourage businesses to increase localization rates, and at the same time develop the automobile industry, aiming at export. Therefore, businesses need to try to save production and business costs, properly account market price. Vietnamese consumers are still "expecting" after 2018 to buy cheap cars because the import tax on complete cars will be reduced to 0%. However, in contrast, some comments also suggest that at that time most of the domestic car manufacturers and assemblers will turn into importers.

Index Terms—Automobile Industry; TRIP; Low Carbon Steel.

I. INTRODUCTION

After a short period of time, the Vietnamese automobile industry has also gathered a number of large automobile corporations in the world such as Ford, Mercedes, Toyota ... and also "formed" up to 18 enterprises. (DN) FDI and 38 domestic enterprises participate in production with a capacity of about 460 thousand vehicles / year, including all types of cars, trucks, passenger cars ... And at some level also meet and timely demand for domestic cars according to the proposed target only in terms of quantity.

The auto industry has also contributed significant revenue to the state budget, averaging over a billion dollars a year - only on taxes and has also created jobs for about 80,000 workers’ dynamic. Besides, it is worth noting that in the past time, this industry has also accumulated a lot of experience in assembling cars and producing some parts and components. This is probably the "premise important" for the development and development of the production-oriented automobile manufacturing industry and future planning. However, the fact for the auto industry to develop according to plans is indeed not to be done overnight. We are still struggling in planning, orientation and development.

The auto industry also confirmed early on the localization rate, but in fact this industry has not yet reached the set criteria. The localization rate is still lower than the set target of 40% in 2005 and 60% in 2010 for common vehicles such as trucks, passenger cars and cars. It is remarkable from the effort of Truong Hai Auto Joint Stock Company (Thaco) to overcome difficulties together with the determination to have a Made in Vietnam-branded product. from 15 to 18% for cars and about 33% for light trucks.

In fact, the industry supports the automobile industry has formed, but still weak. Objectives The Plan sets the domestic production rate for engines and gearboxes at 50-90% by 2010, but so far has not been produced, although the number of enterprises participating in supporting industries is about 210 enterprises so far. But these enterprises are mainly small and medium and only produce a few types of simple parts, with low technology content such as mirrors, glasses, seats, electric wires, batteries, plastic products. ..., some companies invest in stamping lines and tires. In addition, we have not created cooperation, association and specialization among enterprises in the production, assembly of automobiles and the production of spare parts. And there has not yet formed a large-scale system of suppliers of raw materials and components [1]-[5]. The view of rapid development of the automotive industry has been set from high level with a number of important objectives such as localization rate, consumption market is probably still subjective and expected. However, we still have not yet figured out all the difficulties in the development of transport infrastructure, the complexity and erraticity of the Vietnamese automobile market.

In addition, even management agencies and enterprises are not aware of the importance of supporting industries, so the legal framework and policies for developing this industry in general and for the industry automobile industry in particular issued slowly. Although we have preferential policies, but the enforcement of policies is limited, especially credit, because access and preferential loans are difficult and complicated [6]. Therefore, enterprises are mainly interested in assembling cars, this is the thought of eating badly. In addition, it is also necessary to recognize that the domestic automobile market is actually too small, the domestic production and assembly volume is only from 100 to 120 thousand vehicles / year with hundreds of models, types of vehicles, so investing or calling for investment in manufacturing spare parts and components for automobile production and assembly is unattractive because it is difficult to bring efficiency. Even the export of spare parts to countries in the region, the investment enterprises in Vietnam also have little competitive advantage because most of the main materials and materials are not yet produced in the country. In addition, being a latecomer in the region after countries such as Thailand, Indonesia, Malaysia, major automobile corporations when investing in projects in Vietnam all have spare parts supply networks. In the system, Vietnamese enterprises find it difficult to
participate in their global parts and components supply chain [7]. According to managers, Vietnam's transport infrastructure is still weak, not yet creating conditions for demand for the automobile industry. Meanwhile, the unstable and spreading mechanism of tax and charge policies has not really created an effective tool to stimulate the development of this industry.

Thus, the high tax and charge policy for the automotive industry has pushed up the selling price of cars to limit the purchasing power and protection for manufacturing enterprises. In this regard, according to experts, if it is considered as the cause of limiting the purchasing power and protection for domestic manufacturing enterprises, it is necessary to analyze carefully to have an authentic answer.

II. MATERIALS FOR AUTOMOBILE INDUSTRY

Materials in general and alloy steel in particular are a key development direction of each country. Since the late 60s of the 20th century, a new metallurgical technology was born - the technology of producing cast iron by direct reconstitution of iron ore - the production technology of sponge iron was born, gradually replacing the furnace technology high. The technology of sponge iron production has many advantages: without using cups, it reduces a part of the environmental pollution, but more importantly, provides the metallurgical industry with an advanced material, porous iron, with jaws. low carbon content, low content of P, S% impurities, containing trace elements, so that they are more durable and ductile than steel grades with corresponding components made from cast iron and scrap steel.

From new material sources, countries have created many advanced steel families: steel has a very high plasticity used in deep stamping - IF steel, advanced steel grades of high strength AHSS - DP duplex steel, phase shift steel due to TRIP plastic deformation, and other special steel grades. Unlike the Conventional High Strength Steels (Conventional HSS), it is strengthened by solid solution, dispersion phase and granulation, advanced high strength steel is strengthened thanks to transformation of phase and in the nest [8]. The function usually has ferrite, bainite, residual austenite and may have martensite. These steels have high durability, some have good plasticity (suitable for forming), so they are strongly and increasingly applied to fabricate structural details in the automobile and ship industries. Marine, defense industry to meet the technical criteria (high durability, light weight) and safety. In advanced high-strength steel families, steel with phase change due to plastic deformation (TRIP (Transformation Induced Plasticity) Steel - hereinafter referred to as TRIP steel) is a new steel line, with durability, high flexibility, Good fatigue resistance, very suitable for making bearing details needed through shaping.

The plastic deformation transformation effect was introduced by Zackay in 1967, when the study of transforming austenite into martensite appeared in the deformation of some stainless steel. Particularly, residual austenite in the structure of TRIP steel is very rich in carbon and sensitive to plastic deformation. When affected by plastic deformation, residual austenite will transform into martensite and become a hard phase in the substrate. This phenomenon is similar to transforming austenite into martensite in high manganese austenitic steel when subjected to impact loads [9]. As a result, this steel has a high plasticity due to the initial residual austenite in the structure, both high strength after plastic deformation due to austenite transformed into martensite. This steel has been used to produce many details in the automotive industry and is expected to be one of the steel types of the automotive industry in the future. In defense production, these steel grades are also used to make complex shape details, require high-strength vehicles of military vehicles, weapon details, and ship construction [10].

The technology to create steel billets of this type is very complex and requires high technology. The process of making billets must go through two stages: the stage of casting and refining of cast ingot and the process of processing heat to create sheet steel with the right organization. More modern technology can use continuous casting - rolling, alternating heat treatment. In the world, most of the cooking and cooking water from steel ore is then refined and mixed with alloy elements. After creating the cast of swex castings, it is treated with thermo-mechanical process according to hot-rolled or cold-rolled process. However, this process makes the post-cast model vulnerable to defects. The second test trend is carried out on continuous casting equipment; however, this process is a complex process that requires high technology; this has not been done in the country yet.
As the above analysis of TRIP steel fabrication process is a complex process; proactively making TRIP steel fabrication process will contribute to speeding up the localization process of products for transportation industry. Moreover, here the research topic of fabricating this steel from raw materials is sponge iron (available material in the country) [12]-[14]. TRIP steel fabrication process can be summarized in the following diagram form with two main contents: the process of making ingot forming and the process of creating sheet deformation as well as organizational and mechanical investigation of steel.

AHSS steel is refined from porous iron material. The world is conducting a great revolution in metallurgical technology, using direct revert technology (advanced technology) instead of blast furnace technology (classic technology). Direct revert technology has many advantages, not using coke, which means reducing the technology phases - coking and sintering, very expensive and polluted. But more important is to create a new material - direct reconstituted iron (sponge iron), which has many preeminent properties when steel is steeled, so that the quality and productivity of steel is raised.

Advantages of sponge iron:
- C content, P and S impurities are low. Table I shows that porous iron has a basic composition of metal iron, and oxide compounds (CaO, MgO, SiO2, FeO / Fe3O4) and elements C, P, S ... Compared with cast iron furnace high, they have a lower iron content of about 6-8%, but the total iron content is equivalent, the C content is about 2-4 times lower and especially the P and S content is much lower (0.03%) about 3-6 times.
- High combustion efficiency C, high P, S impurities. Because in porous iron always contains a significant amount of iron oxide FeO / Fe3O4 about 6-14%, they are a direct source of oxygen to burn C and P, S impurities without forced oxygen. Thanks to the combustion reaction, the gas generated in the liquid metal, strongly stirred steel water facilitates the rapid transfer of non-metallic impurities and gases to the liquid metal surface; increasing contact between slag and steel water, facilitating the rapid reaction of reducing slag P, S.
- Self-creating slag covering, limiting the gas penetration and heat loss of the furnace due to the oxide-like compounds in porous iron are pushed up on the liquid metal surface to form the cover slag layer (self-contained), while, cast iron and scrap iron need to add fluxes to create coated slag.

Reconstitute iron. Burning reaction C (FeOx + C $\rightarrow$ Fe + CO) is also a reconstituted reaction, adding metal iron to liquid steel tank, improving recovery rate, and also an additional heat source for liquid steel tank.

AHSS steel with superior durability, good ductility always requires precise control of alloy component and refined to eliminate impurities.

AHSS steel is manufactured using specialized mechanical-thermal technology. The core problem in AHSS
Steel production technology is that after refining into the required steel and processing the original deformed billet, the billet must be mechanically-heat treated to create a special multi-phase organization of steel. Fig. 2 shows the types of deformation and heat treatment technologies to create different organizations of AHSS steel. Cast steel billets are machined hot above the temperature of Ac3, controlling the deformation mode to create small, uniform particle organization [18]. Next, heat-processing with deformation technology (hot or cold) and heat treatment by heating at a temperature between Ac1 ÷ Ac3 (also called a biphase or critical region) for a two-phase ferrite organization and austenite, then rapidly cooled to room temperature or isothermal to austenitic to transform into martensite or bainite and residual austenite, while ferrite remains almost the same to create different multi-phase organization in each steel group.

The steel is made from sponge iron with a chemical composition in accordance with ASTM A1079-13, in which the P%, S% content is low, within the set limit. P% and S% components are equivalent, but significantly lower than 10F2C1 steel grades. Causes of low P and S impurities in steel from sponge iron:

Firstly, it must be mentioned that due to the low nature of P, S of porous iron: due to direct reconstitution from iron ore in solid state, not using coke, so impurities P, S are much lower than those of blast furnace;

Secondly, due to the porous structure, when cooking steel water is boiled. Stirring steel water continuously accelerates the transfer of impurities into slag;

Third, certain iron oxide content (~ 10%) in porous iron is a prerequisite for P reduction in the melting phase. Reducing conditions P is the right slag with a basic degree, high iron oxide content and low water temperature. Thus, using steel sponge iron does not need to force the process of creating iron oxide to eliminate P. On the other hand, the loading of porous iron alternating with scrap steel, creating suitable slag, certainly lowering the P content of steel background;

Fourth, porous iron created from Cao Bang iron ore source also retains many elements that are not lost. When cooking, these elements change the reduction conditions of P, S, not only reducing their content but also changing their morphology and distribution in the steel organization. This cause is only predictable, but not by no means because a series of investigation of the chemical composition and mechanical properties of steel from sponge has shown that the content of impurities P and S is very low (<0.03 %) and higher viscosity than the same steel components according to the old standard.

Hot deformation (forging-hot rolling): Hot deformation in addition to breaking down the organization of casting, evenly dispersing impurities and creating embryos of the required size, also works to create small, multi-edge, uniform grain organization thanks to the dynamic recrystallization process that occurs. To break down the casting organization, the strain ratio (γ) must be above 3, but leave small particles and impurities evenly dispersed. According to the rule of hot deformation, the greater the amount of deformation in each machining and the lower the temperature of the deformation, the smaller the particle will be. It is necessary to control the amount of deformation in the range of (25-85)% and the deformation end temperature at the temperature of Ac3, to organize a smooth, evenly small austenite phase, thereby receiving the following smaller particle organization there.

Cold rolling: Cold rolling has the effect of motivating the crystallization process when processing heat afterwards. The greater the amount of distortion, the better will be allowed to organize the final small particle after heat treatment. However, the cold rolling amount is also limited, because if the cold rolling amount is too large, the structure of the material will be broken, the micro-cracking will be formed, then the rough crack will cause material damage.

Two basic parameters of calcination in the area are temperature and firing time, which can control the ratio of ferrite and austenite, the solubility C in two phases and also affect the magnitude of two-phase particles. But it is very important to have indirect effects on residual austenite ratio through the ratio of austenite when heated.

When the temperature and time of calcination increase, the percentage of austenite increases, therefore, when the isothermal cooling in the bainite area, the ratio of unburnt austenitic tends to increase, but because the C content of austenitic decreases, the austenitic ratio has not decreased. On the other hand, because of the low C content in untransformed austenite, to reach equilibrium in a concentration that requires a long period of heat retention, long heat retention is easy to meet the condition of carbide kinetics, therefore, the residual austenite fraction is finally low. In contrast, reducing the temperature and firing time, the percentage of austenite decreases, but the C content increases, they have an opposite effect on the residual austenitic portion. According to C. M. Parish, exists intermediate temperature and firing time, where the ratio of residual austenite is highest.

### III. Conclusion

The uneven development across regions has led to the situation of migration from rural to urban areas with increasing speed. Along with the rapid urbanization and the increase in transportation, the air and urban environment have been seriously polluted, especially in large cities. The level of pollution in big cities is at an alarming level. Therefore, the use of biofuel in gasoline will contribute to improving the environmental pollution by reducing the generation of waste gases in traditional fuels such as CO, SO2, dust particles and CO2. In addition, the development of raw material areas for ethanol production (cassava, sugarcane, algae ...) also contributes to green vegetation which reduces the impact of floods and storms and erosion. Development of biofuels helps countries to be proactive, not dependent on the issue of fuel imports, especially in countries without oil and coal resources. At the same time, curb the increase in oil prices, stabilize the energy profile for the world. The development of biofuels on the basis of utilizing huge biomass resources and being produced from renewable sources will really be a priority option in terms of security, energy security for nations.
REFERENCES


[13] ASTM A 1079-13: “Standard Specification for Steel Sheet, Complex Phase (CP), Dual Phase (DP) and Transformation Induced Plasticity (TRIP), Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process


