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Study of Small and Medium Enterprises (SME) Products in Bangladesh: Performance and Quality Improvement of a Selected Product

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Abstract— Small and medium Enterprises (SME) plays a vital role in the economic development of country especially in the developing countries like Bangladesh. Keeping this concept an attempt has been made to survey the SME products of Bangladesh, study and improve the qualitative performance of a selected mechanical Engineering related SME product. The most difficult part of the project was the survey portion as related project/ research paper in this field is not relatively available. With almost effort lot of information has been gathered related to different range of SME products and related factors. For study and improvement of qualitative performance of cylinder and piston used in Conchi-4 R170 engine has been selected. On study it is formed that the local product quality effort was made for qualitative improvement but due to time constraint that could not be done. In subsequent projects steps may be taken for qualitative improvement using this analysis.

Index Terms— Chemical composition, Cylinder and Piston , Heat treatment, Microstructure test, Rockwell and Brinell hardness number, SME, Sample.

1 INTRODUCTION

Bangladesh is an agricultural country so economy is mainly depending upon it. If it wants to be a developed country from developing country, it needs Industrialization. Because around the world one country is called developed when it is developed in Industrialization and the development of any country is mainly depends on its industrialization. For this reason, despite of being an agricultural country Bangladesh has different small, medium and large industries which need mechanical engineering related products. In Bangladesh the demand of mechanical engineering related products is quite large. To fulfill the demand every year a lot of foreign currency is spent due to import purposes of the mechanical engineering related products.

Bangladeshi products cannot compete the market due to lack of technological knowledge, proper financial support to the producer and some other factors. To overcome the prob-lem strong SME may be a better solution.

In Bangladesh SMEs have special significance for poverty reduction programmes and potential contribution to the overall industrial and economic growth. The contribution of SME's to the GDP is increasing due to smooth release of public loans to this sector, according to sources. If the present industrial policy of Government is implemented properly then the contribution of industrial sector especially SME's to the national economy would reach to 30 to 35 per cent and could create new 35 per cent of new employment.

Considering the prospect of SME an attempt is made in this project to survey the present situation of mechanical related SME products. By this project it was tried to find the present situation of SME, its prospect, obstacles, and contribution of SME to the national economy of Bangladesh.

Now-a -days SME is a very popular term in Bangladesh. Bangladesh Bank and every local bank are giving SME loan to the enterprises. By using the loan they are trying to improve their financial positions as well as they are contributing in national economy. There are different sectors where SME are used. Such as Electronics and electrical, Software Development, Light Engineering and metal working, Agro processing/ agro business/ plantation agriculture/ specialist farming/ tissue culture, Leather making and leather goods, Knitwear and readymade garments, Plastic and other synthetics, Automotive parts and components , Machinery and equipment etc.

In this project it was tried to find the demand for mechanical engineering related products in Bangladesh. By surveying the small and medium organization that is producing mechanical related parts in Bangladesh and make a short list of them.

By analyzing the market demand from different mechanical engineering related products one sample is chosen and it was tried to analyze their different properties & compare their quality with the foreign one and make improvement of the sample product.

From a statistics it is shown that around 34% of imported products are mechanical parts for which a large amount of foreign exchange is used. If it can reduce it will be very good for Bangladesh. After realizing the problem some institutions have come forward for the development of this sector. Government and many other organizations are working together for the betterment of this sector. For this they can take help from the educational institutions where technological knowledge available. By their theoretical knowledge they can help the producers who have practical knowledge but do not have technological knowledge. It will also helpful for the beginning engineer to work in the later life. Realizing the problem this project has been taken.

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2 Objectives and Methodology

2.1 Objectives

The main objectives of this project-

• Surveying the mechanical engineering related products which are available in Bangladeshi market.

• Surveying the SMEs that are producing mechanical engineering related products in Bangladesh & make a list of them.

• Surveying the demand of both Bangladeshi & foreign product in the local market.

• Analyzing the demand of different products choose a sample product and compare its quality & different properties with the foreign product.

• Try to improve the quality of the Bangladeshi sample product.

• Giving further recommendation to improve its quality with considering the cost.

2.2 Methodology

The project effort was aimed to survey which mechanical related product is available in the Bangladeshi market. Among them which are produced here. At the same time project aim was also to compare with the quality of Bangladeshi product with the foreign product and try to improve the quality of Bangladeshi product.

To complete the project some methods are followed. They are

• Defining the survey objectives.

• Survey the market.

• Specifying the strategy for data collection.

• Choose a sample product.

• Collect the sample depending on market demand.

• Making sample from the product for testing, hardness test, micro structure test, chemical composition test.

• See different properties of the microstructure.

• Compare the properties and quality.

• Try to find limitation.

• Try to improve the quality of the Bangladeshi product.

• Giving further recommendation.

At first these methods are selected randomly upon common sense. After starting the project different problems were faced. To solve that problems consulting with different books, studying different website & other paper works, consulting with experts for microstructures methodology were changed time to time & it was decided how to improve the quality of a product.

3 Present Situation

3.1 Imported products by Bangladesh

Bangladesh, being an import oriented country, naturally has to depend on large input of foreign goods. The country imports goods worth about US$ 15 billion each year and increasing.

A more or less representative picture shown that during 1996-97, import payments (Taka 541.8 billion) were about 1.9 times export receipts.

Table 2.1: Major commodities imported in Bangladesh on cash basis

commodities	Percentage
Cotton	18%
Mineral fuels	8.2%
Iron and steel	5.2%
Sulphur, earth and stone, lime and cement	4.2%
Electrical machinery and equipment	3%
Ships, boats and floating structures	2.8%
Fabrics	2.7%
Plastics	2.6%
Vehicles	2.4%

In every quarter around 400000 crore taka is spent for imported. That means the amount of money is around 1600000 crore taka every year. In Bangladesh market is very large. By the technological knowledge and using resources these products can easily made in Bangladesh.

A large portion of foreign exchange is lost due to unavailability of mechanical engineering related products in Bangladesh. Not only in mechanical sector, in other sectors also by using technological knowledge and present resource could good products make. By producing good quality product at first Bangladeshi market can be conquered. After conquering Bangladeshi market, then export can be done. In case of export it should be started from the third world country. For example Japan, China, India may come into consideration. From the beginning they were not developed in this sector. After using their different sources and technological knowledge they are now controlling the electrical and mechanical sector of the world. When their local demand is fulfilled, they start to export in different countries.

3.2 Mechanical engineering related products produced in Bangladesh

Although it is a mechanical base project, so emphasis is given in mechanical sector. By using SME many mechanical related products are produced.

• Cylinders	•Special Purpose Bearing	•Tire Repair Tools
• Piston	•Spherical Plain Bearing	•Tire Inflators
• Worms	•Auto Bearing	•Tire Gauges
• Chains	•Wire Assembly	•Grease Guns
• Couplings	•Tube Assembly	•Diagnostic tool
• Moulds	•Car Mats	•Axles
• Valve	•Car Safety Belts	•Clutches
• Shafts	•Seat Covers	•Transmission Parts
• Transmission Chain	•Steering Wheel Locks	•Drive Shafts
• Gears	•Car Organizers	•Turbochargers
• Gearboxes	•Car Seats	•Auto Filter
• Bearings	•Seat Cushions	•Tank & parts
• Pillow Block	•Boilers	•Muffler Assembly
• Bearings	•Car Perfumes	•Engine Mounts
• Car Jacks	•Steering Wheel Covers	•Car Fenders
• Transmission Jacks		•Pulleys
• Brakes		•Car Bumpers
		•Car Grill

3.3 Contribution of SME Foundation

The SME Foundation is an independent center of excellence created and generously capitalized by the Government of Bangladesh to the tune of a total endowment of Tk. 2 billion.
The abiding mission of the Government of the People's Republic of Bangladesh as regards the development of SMEs is the primacy of pro-poor development of Bangladesh's SMEs in the present age of unceasing globalization, and all-consuming re-structuring. This flagship mission translates into more measureable goals of spurring growth rate of SMEs, upgrading capacities and productivities by existing SMEs and providing stimulus to the emergence of new enterprises, their capacity to generate employment and reduce poverty.
As an integration of markets, internationalization of production network by leading and name-brand companies the vision of SMEs are-
(a) The creation and tasking of a genuinely independent professionally rich expertise;
(b) A level policy playing field for all sizes of enterprises, especially small enterprises;
(c) The creation, updating and dissemination of an integrated information- and –evidence.
(d) The discovery and inculcation of 'systems-approach' regarding what it takes to enable SMEs in Bangladesh.
(e) Unstinted and transparent execution of a plan of action that is well-informed, consensual, future-facing and well-embedded.

3.4 Contribution of SME in Dholaikhal

The business of old motor parts is booming at Dholaikhal, the only hub of spare parts in the Dhaka city, where everything from nuts-bolts to heavy engines, chassis and any sort of outfitting of motor vehicles is available. The motor parts is mainly collected through auctions of old and outdated vehicles held by different government departments including the Bangladesh Water Development Board, Roads and Highways Department, Dhaka City Corporation and Dhaka cantonment.
After filling up the Dholaikhal, the business of motor parts of old vehicles began in the area at small scale during the Pakistan regime in 1960 and it started flourishing after Bangladesh gained its independence in 1971. Now Dholaikhal has turned into mini-motor industrial zone at individual's initiatives. Here mainly reverse engineering is done. No governments came forward to patronize them, though their mechanics without any academic qualification are making parts, engines, chassis and other outfitting for motor vehicles with the parts of old vehicles. Even the mechanics make tempos with shallow pump engines, remake engines, wheel drums and hobs and all kinds of motor outfitting with the parts of old vehicles mainly of Japanese transports. They can separate parts of a motor vehicle within several hours and repair all sorts of machines including generators, plastic factory machines and machinery of other sectors. By their own machine they are making mixer machine, brick breaker, cargo lift, crane etc.
For example "5 brother's engineering" make first mixer machine in Dholaikhal. When it was imported it costs around 2.5-3 lacs taka. But by the technology used in Dholaikhal it costs around 55-60 thousand taka.They do not have any academic education, but they have learnt everything through practical work. They could do more, if they would have got support from the government. According to the motor parts traders, not only transport owners in Dhaka but also from other parts of the country come to Dholaikhal for old and spare motor parts.
There are 4000 to 5000 mini and big shops in Dholaikhal where at least 30,000 to 40,000 people including owners and employees are working to lead their livelihood. The total motor parts business has developed mostly on the land owned by the city corporation. Some traders have also occupied footpaths and two-thirds of Dholaikhal road of the DCC.

3.5 Contribution of Katalyst as developing programme

There are many organizations which are working in developing products in Bangladesh. They are working as a medium between the producers and the consumers. SIT (Systematic Inventive Thinking), BGMEA, BIM, Katalyst etc. organizations are working in this sector. For this thesis work & surveying purpose Katalyst was visited.
Katalyst's approach is designed to benefit the poor as producers, entrepreneurs, employees or consumers. The market development approach it use is based on the premise that better private and public sector business services, and an improved enabling environment lead to more competitive enterprises, which in turn leads to sustainable economic growth and poverty reduction.
They work on a sector wide basis; targeting growth opportunities and removing constraints. In the context of their guiding principles, they develop a comprehensive sector strategy to guide their engagement, identifying leverage potential and synergies, and focusing on achieving scale of impact.
In partnership with market players, Katalyst designs and implements interventions to treat the underlying causes of weak markets, not the superficial symptoms. A key feature of these interventions is that they harness market incentives to encourage scaling up and ensure sustainability.

4 IMPLEMENTATION

4.1 Surveying

One of the major objectives of this thesis was surveying the market to find out what kind of mechanical engineering related products are actually produced by the local industries in Bangladesh. Being unaware of proper surveying knowledge, surveying process was started from root level production shop situated in Dholaikhal by questionnaire method. Normally questionnaire method is of two types-structured questionnaire and open-ended questionnaire, second kind is followed in this thesis.
As the workers employed in different shops in Dholaikhal have no institutional education, they were unaware of importance of this kind of surveying. As a result they were not interested to provide proper information which was required for this survey. That's why after spending a lot of time, sufficient information to complete this survey can't be

gathered.

In this condition SME fair organized by SME foundation provided a direction to continue this surveying. Lots of local industries who produce mechanical related products were participated in this fair including SME foundation. From these industries and SME foundation the surveying was restarted in an organized way.

The survey objectives includes-

•To survey what kind of mechanical engineering related products are actually produced by the local industries in Bangladesh.

•To survey on market demand of the selected products (piston & cylinder) comparative to foreign products.

•To collect information about cost of the selected products (piston & cylinder) comparative to foreign products.

4.2 Sample selection

After completing the survey all gathered information's are analyzed for selecting the sample. Among so many products it was really difficult to find out a sample for quality testing and further development. After various analysis like price, availability, market demand, piston and cylinder of Conchai-4 R170 which is a Chinese engine used in irrigation pump and small size vehicles are selected.

From surveying market some products were considered. They are Drum seeder, Foot pump sprayer, Air filter, Oil Filter, Fuel filter, Rings, crusher, Cylinder Liners, Cylinder Barrels, Refiner Shell, Impeller, Ball Valve, Insulating Joint, Gas regulator, Insulating Locking Cock, Plug Valves.

Then finally choosing product many other things also came into consideration. Bangladesh is an agricultural country. For agricultural purposes many mechanical engineering related products are used. From the Bangladeshi products which are used for agricultural purposes can be improved that will be great achievement for the country and can save a lot of money. After taking decision to improve the quality of products which are used for agricultural purposes there were also many other options. Although Bangladesh is a land of river, water is inadequate. For irrigation purposes farmers are using pump to irrigate their fields. To run the pump a prime mover engine is needed. Piston and cylinders is the prime mover.

From surveying, came into a conclusion that in every season diesel engine which is used for irrigation purposes need to change the piston and cylinder for two times. The piston and cylinder liner has a less life cycle because the pump is placed in a dusty environment. Mainly the pumps are exported from other countries. It may not be manufactured for any other countries. So when producing pumps Bangladeshi environment may not come into consideration. Except it perfect fuel is not used, which also causes to reduce the lifetime.

During the power stroke, up to 4000 pounds (18000N) of force is suddenly applied to the piston head. Temperatures above the piston head reach 4000˚F (2204˚C). Piston must be strong to take this stresses. They must be light enough to reduce inertia loads on the bearings.

Aluminium pistons are either forged or cast. Cast pistons are made by pouring molten aluminium into molds. Forged pistons are hammered out from slugs of aluminium alloy. The alloy, subjected to high forging pressure, flows into dies to form pistons. Both cast and forged piston have to be heat treated. The forged piston is denser, stronger, and has a better heat path so it runs cooler. High performance engine use forged pistons.

Pistons life cycle also reduces due to not present of aluminium alloy perfectly, not doing the heat treatment of the products. For these piston is not made enough strong to take the stresses and withstand the temperature.

There is almost 22 lakhs diesel engine used for irrigation purposes. The cost of piston and cylinder linear which is used here around 200 crore taka. Both Bangladeshi and foreigner piston and cylinder linear are available in the market. Although the Bangladeshi piston and cylinder are cheap in comparison with the foreigner one but due to its quality it cannot compete in the market. If by this project the quality of the Bangladeshi piston and cylinder linear is improved it can compete in the market and the money of Bangladesh will remain here. Another aim is also to reduce the cost of it by technical knowledge. If the cost can be reduced almost 80 taka per piece, then it will be around 20 crore taka per season of the year.

The estimation which is given upwards that is only for the irrigation purpose. Piston and cylinder linear is also used in different purposes. Piston and cylinders are also present in car, marine vehicles, machines which are used for breaking brick etc. If all sectors come into consideration the amount will be large. So it is well understood why this project is chosen.

4.3 Selection of testing procedure

In this selection phase, only those testing are performed which directly impact the performance and life of the cylinder and piston. Hardness test, impact test, abrasive resistance test, material composition test, microstructure test, thermal conductivity test can be performed to compare the samples of Bangladesh and Chin. Among these hardness test, material composition test, microstructure test are performed in this thesis. Impact test, abrasive resistance test, thermal conductivity test cannot be performed due to the lack of lab facilities and unavailability of proper sample.

4.3 Development

After performing the tests that are available in our lab facilities and analyzing the results of the test it is finally concluded that for both piston and cylinder Bangladeshi one is relatively lower in quality than the Chinese one. There were some problems in production procedure of Bangladeshi one in some stages of production. The major stages are material composition, casting procedure and heat treatment. Each stage is very important in parts quality. Material composition and casting is the stage of production before making the parts. Heat treatment is done after the parts are made. For limitation of time and lab facilities first two stages could not be. As heat treatment is the stage which is done after making the parts so only heat treatment was done on the existing Bangladeshi parts. Heat treatment was done by BMTF (Bangladesh Machine Tools Factory) which is a large production industry of Bangladeshi govern-

ment but this step failed due to sufficient knowledge about the heat treatment procedure of the parts which are made of this type of metal composition.

4 TESTING AND RESULT

The variation of main Chemical Composition of Bangladeshi Cylinder Liner and foreign Cylinder Liner shown in figure-1. Pearlitic Gray cast iron used to manufacture reference Cylinder Liner, where in the other hand Bangladeshi Cylinder Liner made by ferritic Gray cast iron. The Pearlitic Gray cast iron has a better physical properties than the ferritic Gray cast iron. Pearlitic Gray cast iron has a tensile strength of 120 ksi where ferritic Gray cast iron has only 80 ksi

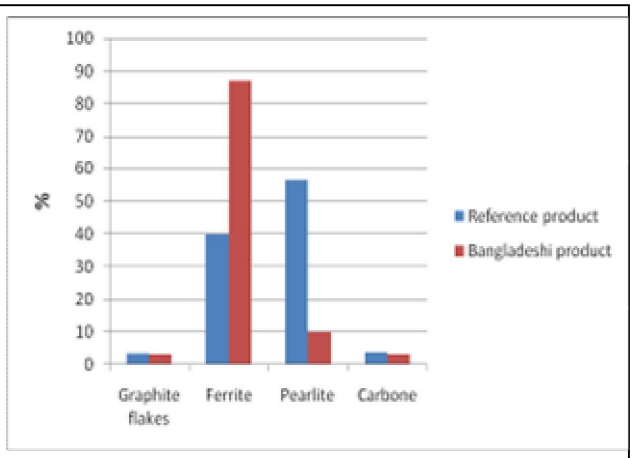

Figure-1: Composition of Reference and Bangladeshi Cylinder Liner.

The Microstructure of Bangladeshi and reference cylinder liner & piston have shown respectively in figure 2, 3 & 4, 5.
For Bangladeshi cylinder liner (Figure 2) microstucture shows ferritic Gray cast iron. Where, White area contains ferrite. Graphite flakes are large in size and in a ferrite matrix with small amount of pearlitic. There are also some MnS inclusions and a few irregular islands of iron - iron phosphate eutectic micro-constituent. These features are seen in most cast irons.
For reference cylinder liner (Figure 3) microstucture shows pearlitic Gray cast iron. Graphite flakes are small in size and in a pearlitic matrix with small amount of ferrite. There are also more MnS inclusions and irregular islands of iron - iron phosphide eutectic micro-constituent. The speckled white regions represent a phosphide eutectic.
For Bangladeshi piston (Figure 4) microstucture indicates alluminium alloy. There are some neddle visible in the stucture which actually indicates primary Aluminium. These primary Aluminium works as crack initiator and actually reduce the strength and life of Aluminium-alloy.
For reference cylinder liner (Figure 5) microstucture which also indicates Aluminium alloy, but there are no neddle visible in the stucture. So this structure have a better strength.
It is also observed that the hardness reference product is higher than Bangladeshi sample product. Figure 6-8 shows the variation hardness in-between reference and Bangladeshi product for three different samples.

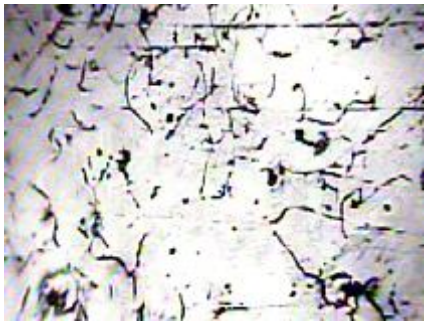

Figure-2: Microstructure of Bangladeshi cylinder Liner (X400)

Figure-3: Microstructure of reference cylinder liner (X400)

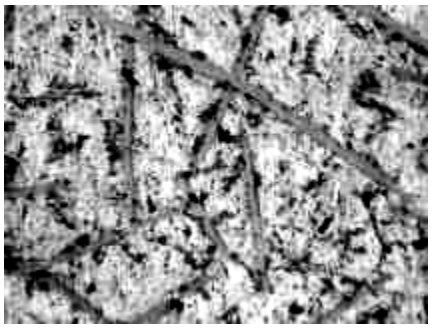

Figure-4: Microstructure of Bangladeshi piston (X400)

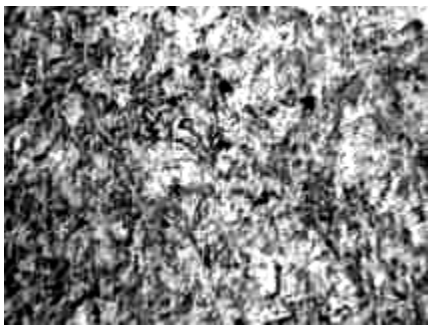

Figure-5: Microstructure of reference piston (X400)

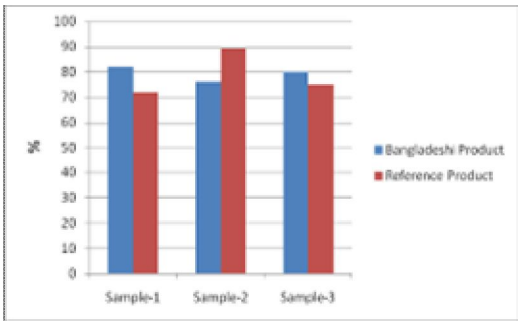

Figure-6: Brinell hardness number of reference and Bangladeshi piston.

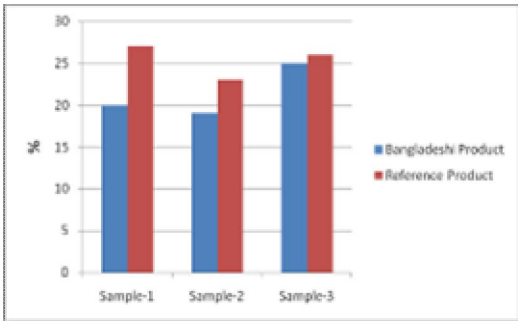

Figure-7: Rockwell hardness number of reference and Bangladeshi Cylinder Liner.

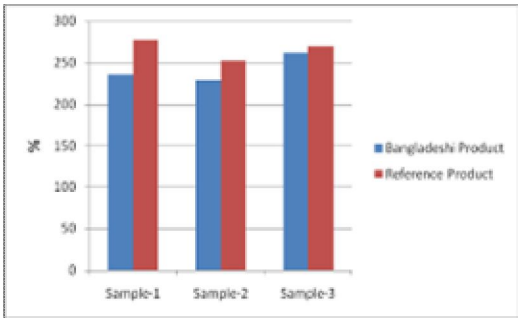

Figure-8: Brinell hardness number of reference and Bangladeshi Cylinder Liner.

It is observed that the hardness of reference and Bangladeshi product almost nearest, but the main difference found in their Chemical composition, which shown in figure-9. In Chemical composition TEST, 90.964% Almunium found in reference product, where in Bangladeshi product it gives valueless number. It is due to the reason, the producer mixed large amount of Lead to increase the machinability.

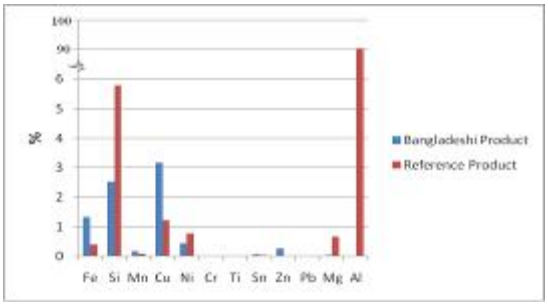

Figure-9: Chemical composition of reference and Bangladeshi piston.

5 DISCUSSION

Presently the market of mechanical engineering related products in Bangladesh is mainly captured by foreign countries such as China, India, Japan, Taiwan etc. Bangladeshi products cannot occupy the market due to lack of quality, high price, reduced operational life etc. This project is done mainly how this problem can be solved and Bangladeshi market can compete by Bangladeshi products. If it can be done properly many foreign currencies can be saved and it will create job facility. If the product quality can be increased then Bangladesh can export the products after fulfilling Bangladesh's demand.

In Bangladesh many mechanical engineering related products are used. By this project it is tried to improve the quality of piston and cylinder because it is used in different types of engine which are used in different purposes. By improving it Bangladesh can save around 200 crore foreign currency and this market can compete by Bangladeshi products.

The present study aimed to prepare an acceptable quality of Bangladeshi product and compare the quality of Bangladeshi Piston and Cylinder Liner with a reference product, where sample product collected from selected famous shops in Bangladesh. Samples were judged by panel of experts by qualities and also were analyzed for chemical and mechanical properties. Significant difference was found in case of Bangladeshi and reference product interns of chemical and mechanical characteristics. Statistical analysis showed that Chemical composition and mechanical characteristics of Reference product were significantly higher than that of Bangladeshi sample product. The main drawbacks of Bangladeshi product are in terms of its alloy composition. By improving the alloy composition the performance of the local product can be brought to international standards. Higher technical institutes like BUET, MIST, IUT and others can play a vital role in improving the qualities of SME Products. In this regard SME Foundation may play a vital role in establishing an Institutional linkage with the industries and institutes.

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