Analysis and Optimization to Enhance Production Rate of Pipe Manufacturing Plant using Matlab: A Case Study

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Abstract- *Productivity plays an important role in any industry which enables a firm to compete in a competitive global world. Productivity provides an idea about how efficiently resources in a company are utilized. This paper addresses the application of cause and effect diagram for a mixing process of pipe manufacturing. Pipe is an essential component which is used in a textile, plastic, rayon, paper mill and printing industry, agriculture, gas etc. For a product to have a good quality, the product should be made with standardize process and with consistent quality. Pipe products are made by mixing process of various ingredients within specific temperature limits. The purpose of this dissertation is to examine the pipe manufacturing process for productivity improvement. The concept of work study for detailed observations is used to improve the productivity. The mixing process design and cutting is taken into consideration, by taking number of trials, problem related with the process are identified. Corrective actions are taken to improve the effectiveness of the equipment used for production process. Based on the observations, a detailed cause and effect diagram is constructed. With the help of this study and after the necessary modifications, the goal is achieved by a proposed standardized production process, which in turn leads to productivity improvement.*

Keywords- Numerical modeling, plasma applications, plasma-arc devices, plasma torches.

I. INTRODUCTION

Population increase and the improvement of living standards brought about by development will result in a sharp increase in food demand during the next decades. Most of this increase will be met by the products of irrigated agriculture. At the same time, the water input per unit irrigated area will have to be reduced in response to water scarcity and environmental concerns. Water productivity is projected to increase through gains in crop yield and reductions in irrigation water. In order to meet these projections, irrigation systems will have to be modernized and optimised. Steel pipes are long, hollow tubes that are used for a variety of purposes. They are produced by two distinct methods which result in either a welded or seamless pipe. In both methods, raw steel is first cast into a more workable starting form. It is then made into a pipe by stretching the steel out into a seamless tube or forcing the edges together and sealing them with a weld. The first methods for producing steel pipe were introduced in the early 1800s, and they have steadily evolved into the modern processes we use today. Each year, millions of tons of steel pipe are produced. Its versatility makes it the most often used product produced by the steel industry.

II. DESIGN

There are two types of steel pipe, one is seamless and another has a single welded seam along its length. Both have different uses. Seamless tubes are typically more light weight, and have thinner walls. They are used for bicycles and transporting liquids. Seamed tubes are heavier and more rigid. The have a better consistency and are typically straighter. They are used for things such as gas transportation, electrical conduit and plumbing. Typically, they are used in instances when the pipe is not put under a high degree of stress.

Certain pipe characteristics can be controlled during production. For example, the diameter of the pipe is often modified depending how it will be used. The diameter can range from tiny pipes used to make hypodermic needles, to large pipes used to transport gas throughout a city. The wall thickness of the pipe can also be controlled. Often the type of steel will also have an impact on pipe's the strength and flexibility. Other controllable characteristics include length, coating material, and end finish.

Raw Materials

The primary raw material in pipe production is steel. Steel is made up of primarily iron. Other metals that may be present in the alloy include aluminum, manganese, titanium, tungsten, vanadium, and zirconium. Some finishing materials are sometimes used during production. For example, paint may be used if the pipe is coated. Typically, a light amount of oil is applied to steel pipes at the end of the production line. This helps protect the pipe. While it is not actually a part of the finished product, sulfuric acid is used in one manufacturing step to clean the pipe.

The Manufacturing Process

Steel pipes are made by two different processes. The overall production method for both processes involves three steps. First, raw steel is converted into a more workable form. Next, the pipe is formed on a continuous or semi continuous production line. Finally, the pipe is cut and modified to meet the customer's needs.

Ingot production

I. Molten steel is made by melting iron ore and coke (a carbon-rich substance that results when coal is heated in the absence of air) in a furnace, then removing most of the carbon by blasting oxygen into the liquid. The molten steel is then poured into large, thick-walled iron molds, where it cools into ingots.

In order to form flat products such as plates and sheets, or long products such as bars and rods, ingots are shaped between large rollers under enormous pressure.

Producing blooms and slabs

To produce a bloom, the ingot is passed through a pair of grooved steel rollers that are stacked. These types of rollers are called "two-high mills." In some cases, three rollers are used. The rollers are mounted so that their grooves coincide, and they move in opposite directions. This action causes the steel to be squeezed and stretched into thinner, longer pieces. When the rollers are reversed by the human operator, the steel is pulled back through making it thinner and longer. This process is repeated until the steel achieves the desired shape. During this process, machines called manipulators flip the steel so that each side is processed evenly.

Ingots may also be rolled into slabs in a process that is similar to the bloom making process. The steel is passed through a pair of stacked rollers which stretch it. However, there are also rollers mounted on the side to control the width of the slabs. When the steel acquires the desired shape, the uneven ends are cut off and the slabs or blooms are cut into shorter pieces.

Further processing

Blooms are typically processed further before they are made into pipes. Blooms are converted into billets by putting them through more rolling devices which make them longer and more narrow. The billets are cut by devices known as flying shears. These are a pair of synchronized shears that race along with the moving billet and cut it. This allows efficient cuts without stopping the manufacturing process. These billets are stacked and will eventually become seamless pipe.

Slabs are also reworked. To make them malleable, they are first heated to 2,200° F (1,204° C). This causes an oxide coating to form on the surface of the slab. This coating is broken off with a scale breaker and high pressure water spray. The slabs are then sent through a series of rollers on a hot mill and made into thin narrow strips of steel called skelp. This mill can be as long as a half mile. As the slabs pass through the rollers, they become thinner and longer. In the course of about three minutes a single slab can be converted from a 6 in (15.2 cm) thick piece of steel to a thin steel ribbon that can be a quarter mile long.

After stretching, the steel is pickled. This process involves running it through a series of tanks that contain sulfuric acid to clean the metal. To finish, it is rinsed with cold and hot water, dried and then rolled up on large spools and packaged for transport to a pipe making facility.

Pipe making

Both skelp and billets are used to make pipes. Skelp is made into welded pipe. It is first placed on an unwinding machine. As the spool of steel is unwound, it is heated. The steel is then passed through a series of grooved rollers. As it passes by, the rollers cause the edges of the skelp to curl together. This forms an unwelded pipe.

The steel next passes by welding electrodes. These devices seal the two ends of the pipe together. The welded seam is then passed through a high pressure roller which helps create a tight weld. The pipe is then cut to a desired length and stacked for further processing. Welded steel pipe is a continuous process and depending on the size of the pipe, it can be made as fast as 1,100 ft (335.3 m) per minute.

When seamless pipe is needed, square billets are used for production. They are heated and molded to form a cylinder shape, also called a round. The round is then put in a furnace where it is heated white-hot. The heated round is then rolled with great pressure. This high pressure rolling causes the billet to stretch out and a hole to form in the center. Since this hole is irregularly shaped, a bullet shaped piercer point is pushed through the middle of the billet as it is being rolled. After the piercing stage, the pipe may still be of irregular thickness and shape. To correct this it is passed through another series of rolling mills.

Final processing

After either type of pipe is made, they may be put through a straightening machine. They may also be fitted with joints so two or more pieces of pipe can be connected. The most common type of joint for pipes with smaller diameters is threading—tight grooves that are cut into the end of the pipe. The pipes are also sent through a measuring machine. This information along with other quality control data is automatically stenciled on the pipe. The pipe is then sprayed with a light coating of protective oil. Most pipe is typically treated to prevent it from rusting. This is done by galvanizing it or giving it a coating of zinc. Depending on the use of the pipe, other paints or coatings may be used.
Quality Control

A variety of measures are taken to ensure that the finished steel pipe meets specifications. For example, x-ray gauges are used to regulate the thickness of the steel. The gauges work by utilizing two x rays. One ray is directed at a steel of known thickness. The other is directed at the passing steel on the production line. If there is any variance between the two rays, the gauge will automatically trigger a resizing of the rollers to compensate.

III. PROPOSED METHODOLOGY

In the previous researches such as ASP and alb optimization shows that many soft computing ways were used. This shows that the number of papers is using differing kinds of soft computing strategies to optimize ASP and alb problems for the last 10 years. The 3 most dominant optimization methods which had been used earlier is about seventieth of the summon analysis are Genetic algorithmic rule, ant colony optimization and Particle swarm optimization.

Solve problems, researchers could use algorithmic rule that should terminate during a finite number of steps or iterative methods that converge into a solution on some specified category of problems, or heuristics which will give approximate solution to many problems and their iterates doesn't need to converge it. Optimization algorithmic rule is less complicated, easier and designed for linear programming.

Genetic algorithmic rule is inspired by the evolutionary processes that are based on the natural evolution. This method emulate the biological evolution theory.GA provides a method of looking out process that doesn't need to traverse every possible solution within the feasible region to get a good and correct result. Genetic algorithmic rule may be a heuristic search that mimics the method of natural selection.

Heuristic methods in assembly line balancing problem:

The heuristic approach bases on logic and common sense rather than on mathematical proof. Heuristics don't guarantee an optimum solution, but results in good feasible solutions which approach the true optimum. Most of the represented heuristic solutions in literature are those designed for solving Single assembly line leveling drawback. Moreover, most of them are supported simple priority rules (constructive methods) and generate one or a number of feasible solutions. Task-oriented procedures select the highest priority task from the list of obtainable tasks and assign it to the earliest station which is assignable. Among task-oriented procedures we will distinguish immediate-update-first-fit (IUFF) and general-first-fit strategies depending on whether the set of {available|of obtainable|of accessible} tasks is updated instantly when assignment a task or when the assigning of all currently available tasks. Because of its greater flexibility immediate-update-first-fit technique is used more frequently. The most idea behind this heuristic is assigning tasks to stations basing on the numerical score. There are several ways in which to determine (calculate) the score for every tasks. One could easily create his own method of determining the score; however it's not obvious if it yields good result. Within the following section five completely different methods found in the literature are given along with the solution they provide for our simple example. The methods are implemented within the Line leveling program as well. From the moment the appropriate score for every task is decided there's no difference in execution of methods and therefore the required steps to obtain the solution are as follows:

Assign a numerical score n(x) to each task x.

Update the set of accessible tasks (those whose immediate predecessors have been already assigned).

Among the available tasks, assign the task with the highest numerical score to the primary station within which the capacity and precedence constraints won't be violated go to STEP two.

The most popular heuristics which belongs to IUFF group are:

IUFF-RPW Immediate Update 1st Fit – Ranked Positional Weight,

IUFF-NOF Immediate Update 1st Fit – Number of Followers,

IUFF-NOIF Immediate Update 1st Fit – Number of Immediate Followers,

IUFF-NOP Immediate Update 1st Fit – Number of predecessors,

IUFF-WET Immediate Update 1st Fit – Work component Time.

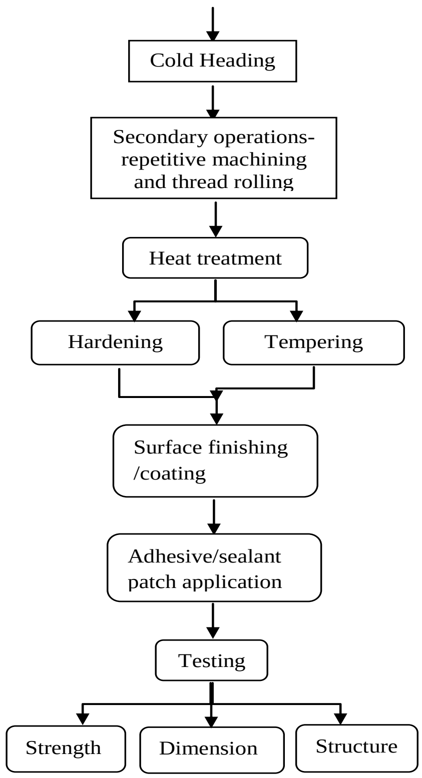

Fig: - flow chart representation of the work

During the stage of producing processes, assembly optimization is concentrated on 2 major activities. The primary activity is deciding the optimum automation level in assembly. The aim of this activity is to use the suitable automation level in assembly so as to balance the investment in automation and therefore the output. The second activity during this stage is assignment the assembly tasks into workstations, such workstations have equal or nearly equal load. This activity is typically called assembly line balancing (ALB). [9]In this stage, analysis within the assembly optimization offers a lot of attention on vestment drawback instead of the optimization of automation level. It is often observe through the quantity of publication in optimizing each issue. Originally, assembly lines were developed for a value economical mass-production of standardized product, designed to use a high specialization of labor and therefore the associated learning effects. Since the days of industrialist and also the notable T–model, however, product necessities and also the thereby the necessities of production systems have modified dramatically.[2] so as to reply to varied client desires, firms need to afford an discrimination of their product.

IV. RESULT

This result analysis is part of research which takes some data of the company. This company is design several mechanical element like bolt, screw and Bearing. In this

Thesis is showing the analysis part of Pipe Production.
Which follow several processes to design –

1. Cold heading
2. Secondary operations-repetitive machining and thread rolling
3. Heat treatment
4. Surface finishing/coating
5. Adhesive/sealant patch application
6. Testing

This above all process is station which have own work and also have some worker. In above some process (station) have some co-part.

Table 5.1 is show initial work of the company, which is performed without use line balancing.

In this industries first calculate distance of each station and its –

In this industries apply line balancing (SALBP), Kilbridge-Wester Heuristic approach, and Helgeson-Birnie Approach with optimized method artificial intelligence.

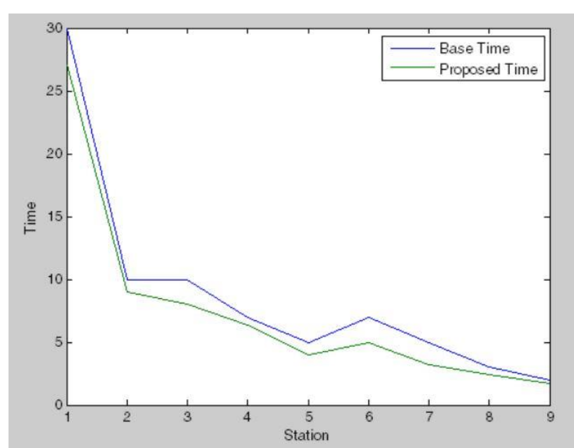

Fig 5.1 Time Compares

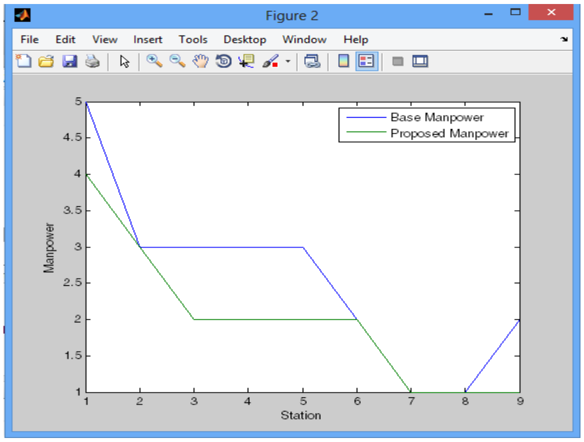

Fig 5.2 Manpower Compares

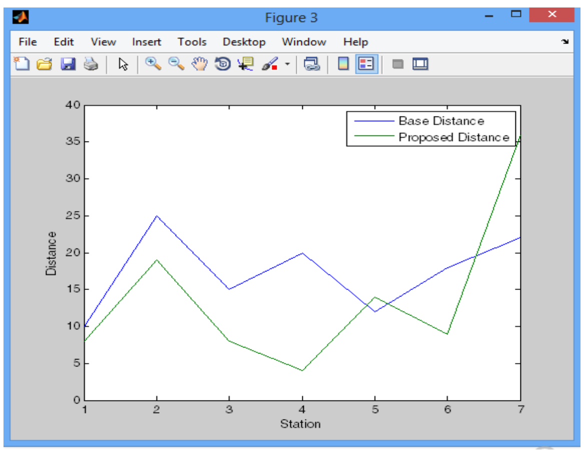

Fig 5.3 Distance Compares

V. CONCLUSION

Current analysis and study is give better result. Hence The Proposed method should be employed at a basic unit which is employed at the complete unit to give high production and also provides a cost which should be affordable. Here proposed architecture change working area and procedure also optimized arrangement and cutting structure. Cutting is major issue of high production so proposed method is proposed automation cutting. A study on the influence of times and the precedence graph format of the tasks in the results of production methods is another recommendation.

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