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Selection of Condenser Tube Material through A mixed Balanced Score Card and AHP approach.

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Abstract

Energy requirements for worldwide power scenario and also the need of Power for energy growth and performance of the power stations, Condenser tube types, construction, and performance of the power plants and to get maximum efficiency of the system, for selection of the condenser tube material is a scientific approach to select the suitable materials for condenser which will give maximum efficiency and also long life of the material. This materials which will have anti corrosion properties, strength and also cheaper. This study proposed an integrated Balanced Scorecard– Analytic Hierarchical Process (BSC–AHP) model to select the suitable Material required for Condenser tube. In this subject many literature studies have been made and this approach to find through specific Measure of the special criteria of the material and accordingly the BSC and AHP has been applied and select the best material for fossil and nuclear power plants.

Keywords; Material selection; Performance measurement; BSC (Balance score card); AHP (Analytic Hierarchy process).

INTRODUCTION

Now a day's energy becomes the major criteria for the development for a country. Nuclear power offers great promise in helping to reduce greenhouse gas emissions and also supplementing the energy supply to meet increased future demand. A heat exchanger is a heat-transfer devise that is used for transfer of internal thermal energy between two or more fluids available at different temperatures. In most heat exchangers, the fluids are separated by a heat-transfer surface, and ideally they do not mix. Therefore, selecting the best suitable material for condenser tube is always welcomed by every energy industry. In this literature several studies deal with the various material selecting procedures with various factor affecting with the efficiency criteria. The aim of this study is to apply a Balanced Scorecard and Analytic Hierarchy Process (AHP) to select the most appropriate material for better Condenser performance. The proposed approach is also applied to a problem of selecting the material with various properties.BSC be fitted to the specific industries to be efficient. However, considering specific performance measure for the material selection of condenser tube can be beneficial due to following:

a) In the Power Plants the main efficiency is the Performance of the condenser and by selecting the right material for condenser tube will increase the performance of the condenser and also the efficiency of the power plant.

b) By selecting the best condenser tube material it will help and increase the efficiency of the system and give long life of the system.

c) the Mathematical models are precise tools to combine all the selection criteria put together and select the best one. This will be more precise when the decision maker has the option of making the decision.

LITERATURE REVIEW

There are various studies on the evaluation and selection of Condenser tube materials such as Selection of Materials for Heat Exchangers by P. Rodriguez (1997), this paper made a frame work for selecting heat exchangers materials especially those used in nuclear power plants. The paper brings out also, the importance of continued intensive R &D in materials in order to enhance the reliability and reduce cost by improving upon the existing materials by minor additions of allying elements or new materials. Daniel S. Janikowski, (2003) provide an overview on a number of factors known to cause failure of a tube or pipe materials. Knowing the limitations of materials is crucial when making a selection for specific application. It helps to identify the factors that need to be considered when selecting materials. Properties compared in this paper include corrosion resistance, stress corrosion cracking potential, thermal and mechanical properties, erosion resistance, vibration potential, and temperature limitations. BSC – AHP Integration.

This paper deliver the selecting the material using through BSC and AHP Method and Sharma and Bhagwat incorporated BSC & AHP method for supply chain assessment. This paper described a balanced performance assessment structure for supply chain. Yuksel and Dagdeviren did a case study analysis for manufacturing firm using FANP-BSC. This research revealed that BSC framework can be merged with fuzzy ANP Method. Wu et.al. Suggested a fuzzy MCDM method for assessing banking performance based on BSC. Bentes et al. incorporated BSC and AHP for the goal of multi dimensional evaluation of organizational performance. This research showed that the BSC and AHP can be

integrated for the aim of performance measurement. Research by Chang et al. used the BSC in constructing a framework of wealth management (WM). The suggested model helped the banking sector in evaluating the organizational performance of WM banks, making it extremely appropriate for bank administrators.

In this paper an efficient and suitable Material selection framework to propose specific measures of Power Plants developed. In this method so many performance measures in the literature makes the selection of material task confusing and expensive. A fit material selection frame work is needed to use a specific performance measurement approach for the aim of evaluating materials. Trying to fill the gap in the literature, this study proposed an integrated BSC – AHP model for evaluating and selecting material by considering the characteristics of Power plants, in order to assist the designers and managers to efficiently handle their material selection decision.

RESEARCH METHODOLOGY

A Detailed literature review was conducted and a list of measures was gathered (see Table 1). The output of this phase was an initial list of measure proper to be used for material selection. Next, a new BSC was proposed for the aim of assessing material criteria with variable methodology and then following, a group of experts in the field of power plants engineering and to finalize the metrics of new BSC. Afterward, the proposed BSC was used to select the material. To achieve this goal, measures BSC were used to assess the criteria of each material and the results were used for the next step. Subsequently, AHP was applied to select the best material. The justification of using AHP was its ability to consider different perspectives of BSC simultaneously.

A PROPOSED BSC

As per the Literature survey study, a new BSC was Proposed for the aim of selection of material in the power plants. a group of experts were asked to propose the new BSC . Table 2 shows the proposed BSC.

MATERIAL SELECTION CRITERIA

The proposed BSC was used to power plants for material selection from the expert's opinion. Fig. 1 presents the material selection criteria by applying the proposed BSC. The result is divided in to four different sections showing BSC's perspective. Quantities shown at the top of each column display the score achieved by each material. The scores were calculated using related opinion given by experts.

MATERIAL SELECTIO USING AHP

Material selection is categorized as an MCDM problem. Many researchers used MCDM techniques with the objective of solving supplier selection problem such as AHP, TOPSIS, and ANP.

AHP was primarily introduced by Saaty in 1971. It abridge decision making by systematizing opinions, emotions, decisions, and memories into a structured environment. Once the hierarchy has been created, the decision-makers start the prioritization process to decide the relative significance of the components in each level. The scale deployed for judgments in AHP allow the decision maker to integrate the knowledge and experience instinctively and specify how many times elements dominates another with respect to the criterion. Within the literature, AHP has been largely used to discover answers for many complex decision-making problems.

One of the important steps of AHP technique is to place the comparison metrics. When the number of attributes or alternatives in the hierarchy increases, more judgments between features (or alternatives) require to be made. This could simply cause bewilderment, because of the overload of question and therefore the inefficiency of the model. So consistency check is needed for the pair wise comparison matrix. When the comparison matrices are not consistent, we should adjust the elements in the matrices and carry out a consistency test until they are consistent.

There are five Materials have been selected for this study to evaluate the best condenser tube material namely, 1. brass, 2. Aluminum, 3. Stainless steel, 4. Cu-Ni alloy and 5. Titanium. The proposed Material selection through BSC is shown in Table (1). In this study will consider the four aspects like Financial Aspects , Customer perspective, Internal Business perspective and Leaning and Growth perspective.

Table 1. Proposed BSC for Material Selection

Financial Aspects	Customer Perspective.
Initial Cost	Tensile Strength
Maintenance Cost	Toughness
Loss of Production Cost	Fracture

Internal Business	Learning and Growth
Heat Transfer	Resist to Corrosion
Thermal Expansion	low Corrosion
Weight	Resist to Sulfur

Table 2. Partial list of BSC performance measures found in the literature.

Author	Year	Financial	Strength	Physical Properties	Corrosion
[1]	2005	Waste reduction Level Cost saving level Recapturing value	Convenience Customer service Green products	Competitiveness Product recovery Commitment by top management	IT Option Monitoring of suppliers Formation of strategic Alliances
[2]	2010	Profitability Revenue growth	Customer satisfaction Market share	new technologies Ration of new products to total products	Knowledge management Employee satisfaction
		EVA Brand recognition	customer loyalty Risk minimization	Inventory turnover Productivity	Training hours Knowledge sharing. Corporate values adoption
[3]	2011	Cost reduction level	Supply chain collaboration	Quality of products	Flexibility to change level

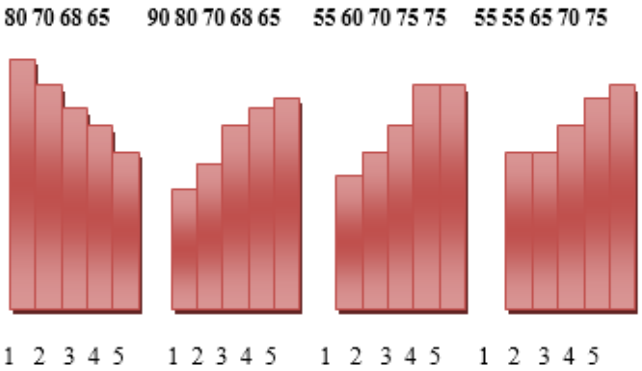


Figure 1. Materials are numbered as defined.

Figure 2: Material Performance Measurement using proposed BSC.

Table 3. Saaty's Scale for pair wise comparison

AHP scale	The relative importance of the two sub elements.
1	Equally important.
2	Moderately important with one over another
5	Strongly important
7	Very strongly important.
9	Extremely important.
2,4,6,8	Intermediate Values.

Table 4. Pair wise comparison under financial criteria.

Criteria **Financial**	BR	AL	SS	CU	Ti	Norm
BR	1	.8	1	1.2	1.3	.2
AL	1.1	1	1.1	1	1.1	.21
SS	1.1	1.1	1	1.1	1.2	.21
CU	1.2	1.2	1.1	1	1.1	.19
TI	.7	.7	.8	.9	1	.18

Table 5. Pair wise comparison under Material Strength criteria.

Criteria **Customer**	BR	AL	SS	CU	Ti	Norm
BR	1	.9	.8	.75	.6	.14
AL	1.2	1	.8	.7	.6	.16
SS	1.4	1.2	1	.9	.7	.20
CU	1.6	1.5	1	1	.9	.21
TI	1.6	1.5	1.4	1.2	1	.26

Table 6. Pair wise comparison under Physical Properties.

Criteria **Internal Business**	BR	AL	SS	CU	Ti	Norm
BR	1	.9	.8	.8/	.7	.14
AL	1.2	1	.9	.8	.6	.16
SS	1.4	1.2	1	.9	.8	.2
CU	1.5	1.3	1.1	1	.9	.21
TI	1.7	1.6	1.2	1.1	1	.25

Table 7. Pair wise comparison under Corrosion Properties.

Criteria **Learning And growth**	BR	AL	SS	CU	Ti	Norm
BR	1	1	.8	.8	.7	.16
AL	1	1	.9	.8	.8	.17
SS	1.4	1.2	1	.9	.8	.20
CU	1.5	1.3	1.1	1	.9	.21
TI	1.6	1.5	1.2	1.1	1	.23

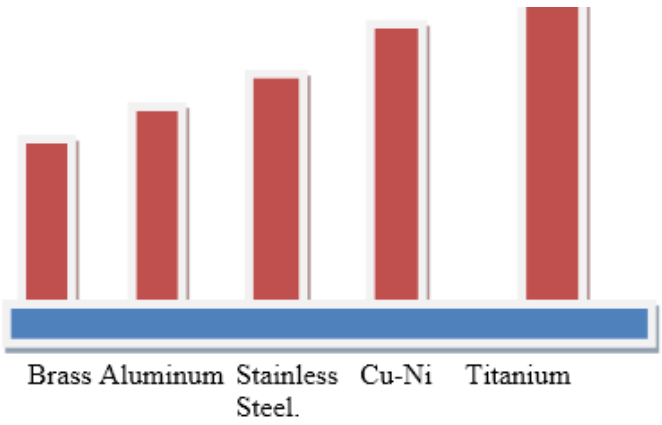
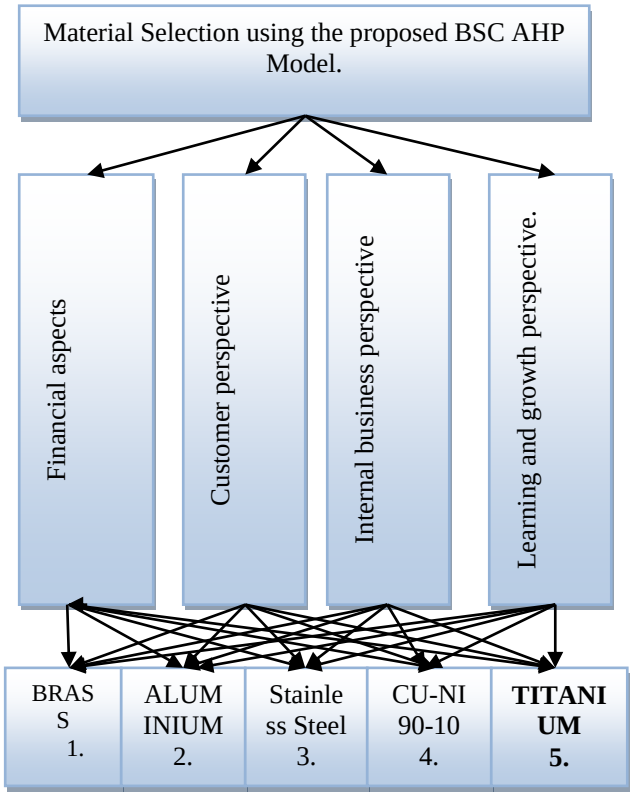


Figure 3. Material Selection analysis Hierarchy Model.

Table 8: Materials Selection proposed BSC & AHP



CONCLUSION

This Method of BSC- AHP Balanced Scorecard-Analytic Hierarchical Process process study developed to select the best material required for condenser tube material for Power station. This type of selection is less studied in Power plant areas. To fill this gap this study was conducted and recommended new BSC framework for Material evaluation. The BSC frame work for material selection and evaluation for Power production industry in each criteria (Financial, customer perspective, internal business and learning and Growth perspective) was proposed for material performance measurement. Each critical criteria was collected with literature survey and using AHP choose the best material.

This type of study help to develop for further future studies. The proposal study of BSC AHP integrates with other MCDM tools such as ANP, PEA etc.,

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