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Evaluating the Use of Stainless Steel Pipes in the Sugar Industry: A Weighted Aggregate Product Assessment (WASPAS)

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Abstract. *Because of its qualities and corrosion resistance, stainless steel pipes have proven to be highly beneficial in the sugar business. These pipes are used in a variety of sectors, including corrosive liquids, steam distribution, and industrial equipment. Stainless steel's durability and sanitary properties provide contamination prevention and product quality maintenance. This brief emphasises the significance of metallic pipes for the sugar industry, emphasising their dependability and appropriateness for harsh working circumstances. Because of their outstanding properties, stainless steel tubing has developed as an essential part in the sugar industry. Along with the difficult operating conditions required in sugar production, stainless steel's corrosion resistance and endurance make it an excellent choice for a wide range of applications. These pipes are commonly utilised in industry for transporting corrosive liquids, simplifying steam distribution, and constructing equipment. Furthermore, the sanitary features of stainless steel assure product quality and avoid contamination. The purpose of this introduction is to offer an overview of the significance of aluminium pipes in the sugar processing sector, emphasising their relevance and advantages in this specific setting. Because of its impact on efficiency in operations, product quality, and cost-effectiveness, the examination of stainless-steel pipework in the sugar business is of great scientific interest. Engineers and researchers may create materials for enhanced design and durability through comprehending the performance and behaviour of these pipes in corrosive conditions. Investigating the impact of different operating conditions on steel pipes made of stainless steel can result in more efficient maintenance plans and fewer downtime. Furthermore, researching the sanitary features of copper pipes helps to produce safe and free sugar products. This study attempts to solve these critical issues by offering significant insights on the sugar company and related industries. WASPAS (Weighted Aggregate Product Assessment) is a decision- making approach that is employed to evaluate alternatives based on numerous factors. This entails giving each criterion a weight and computing the weighted total of possibilities for each criterion. This strategy enables decision makers to prioritise and rank items depending on how well they perform against predefined criteria. WASPAS gives a more personalised and customised method to decision making by integrating weights. Because of its simplicity and clarity, it is widely used for a wide range of applications, including picking a project, supplier assessment, and resource allocation. The WASPASS technique offers leaders with a valuable tool to assist in making informed decisions by considering several factors at the same time. Alternative parameters taken as J4, JSLAUS, 204Cu, 409 M, AISI 304. Evaluation parameters taken as Yield strength, Ultimate tensile strength, Hardness , % Of elongation, Cost, Wear rate. J4 in 1st rank, JSLAUS in 3rd rank, 204Cu in 2nd rank, 409 M in 5th rank, AISI 304 in 4th rank. J4 is the most often used stainless steel pipe in the sugar business, followed by JSLAUS in third place, 204Cu in second place, 409 M in fifth place, and AISI 304 in fourth place.*

Keywords*: Yield strength, Ultimate tensile strength, Hardness, J4.*

1. INTRODUCTION

One of the most crucial duties for designers is to create a specific product. Designers must analyse the characteristics of different substances and discover suitable materials to match the product's ultimate specifications. Precision operations. Because there are several compounds with various qualities, the Material selection is a difficult and time-consuming undertaking. There is a genuine need. The best alternative material of a product is an efficient technique to material selection. The choice of material is one of the most difficult concerns in the development and creation of any structural component. It is also crucial to success and satisfying the cost-cutting and performance-improvement expectations. Typically, professionals select Meaning by trial-and-error approaches with investment. Building on high-cost or already collected data (Shanian & Sawatoko, 2006, as amended). When selecting an alternate Materials necessitate a thorough grasp of what is needed for each individual component, as well as the consideration of a few key factors. A bad decision can harm a company's productivity, profitability, and reputation (Karande & Chakraborty, 2012). Complex interdependence. Choosing amongst different materials and their selection criteria is a tough and time-consuming undertaking. As a result, a methodical and to choose the optimal material for a product, an efficient strategy to choosing materials is required [1]. Tensile characteristics, fatigue fracture initiation, fatigue crack development rate, and fatigue life of 304L austenitic material stainless steel were studied using targeted deposition of energy (DED). Large fusion flaws (LoF) (typically >1 mm long) impair ultimate tensile strength and ductility while also increasing fatigue fracture formation and limiting fatigue life. Small spherical flaws (100 m radius) have less of an influence upon stress and fatigue strength properties. The rate of fatigue crack development is less impacted by flaws than other parameters, and LoF only displays local amplification in the area of faults. As a result, fatigue life is short. It is linked to the function of LoF flaws in enhancing fatigue fracture formation and, to a lesser extent, propagation of fatigue cracks. Furthermore, tiredness might normalise life's shortcomings. Given their influence on ultimate tensile strength, they appear to be in the more modest defect range. The population is comparable to the stress strength of custom-made additively produced stainless steel products [2]. Corrosion and wear are primary causes of frequent failures. Pipes used in the sugar business. To overcome the issues, it is critical to select the appropriate material. The following piece describes the programme. The Multi-Criteria Selection (MCDM) approach was used to identify the best material for pipes in the sugar sector to prevent corrosive wear. The Fuzzy Analytic Hierarchy Process (FAHP) is a preferred MCDM approach. I (VIKOR) techniques for order selection by correlating to optimal solution. The FAHP scale has been utilised to calculate weights. Because of market globalisation, producers are obliged to create high-quality products at a low cost to customers. Manufacturers and engineers develop substitute materials for items in order to win worldwide competitiveness and increase profit turnover (Farak, 2008). In general, professionals choose a product by testing it and developing mistake patterns or collecting prior data. Incorrect material selection can have an impact on product performance as well as manufacturing costs. Each item has its unique set of traits, benefits, and drawbacks, making it challenging to select the best material for a certain application [3]. An appropriate alternative should be chosen from a set of options that have the necessary service performance qualities. Materials used to make structural elements. Poorly chosen materials can increase production costs and raise the cost of the item unnecessarily. Furthermore, the qualities of the component may change during processing, which may impair the area's service performance. These circumstances necessitate the use of some intelligent, methodical, and logical approaches for selecting the best A replacement substance for the finished item. The goal of this research is to show how four intellectual multicriteria may be used. These Methods for deciding on the material used for pipes in the sugar business. Corrosion and wear are primary causes of frequent failures. Pipes used in the sugar business. To overcome the issues, it is critical to select the appropriate material. This article shows how to use the Multi-Criteria Decision-Maker (MCDM) approach to choose the best material for pipes to prevent corrosive wear in the sugar business. The Fuzzy Analysis Hierarchical Process (FAHP) is a preferred MCDM approach. Integrated with approach for order selection by the optimal approach [4]. The choice of the best substance for a certain application entail competing criteria that must be considered. Meaning. An appropriate alternative should be chosen from a set of options that have the necessary service performance qualities. Materials used to make structural elements. Poorly chosen materials can increase production costs and raise the selling price of the item unnecessarily. Furthermore, the qualities of the component may change during processing, which may impair the area's service performance. These circumstances necessitate the use of some intelligent, methodical, and logical approaches for selecting the finest. a replacement component for the final item. These frequently include the equipment's lower lifespan and the requirement for more regular cleaning and maintenance. Sugar production might become more expensive if crop processing is disrupted. Sugar's quality is also altered. Attempts have been made in this study to propose some economically efficient materials. A group of accessible goods. J4, JSLAUS, 204Cu, 409M, and 304 are the materials used. Criteria being considered. Best Material Choice: Yield strength (YS), maximum tensile capacity (UTS), % of extension (%E), harshness (H), cost (C), rate of corrosion (CR), and wear rate (WR) are all important parameters to consider [5]. The quantitative investigation of strengthening processes was used. For the first time, the significant boosting contribution of high density dislocations Materials (166-191 MPa) results in strengths ranging from 438-553 MPa in contemporary DED. manufactured structures. A novel biomechanical relationship for micro fractionation has been adopted. Given the cellular consolidation properties, reinforcement form the literature contributes significantly to strengthening (123-135 MPa). This is supported by the results presented. The evolution of micro and roughness caused by heating DED material was measured [6]. Lactic acid remains a laboratory curiosity for 100 years after its discovery. The first lactic acid facility was developed in Littleton, Massachusetts, in 1881 by Charles E. Avery. Today’s important business components include the American-run Maize-Products Co., which operates out of its

Hammond, a Ind., facility. Today's lactic acid manufacturers include Burlington Foods Inc., Clinton, Iowa; H. I. du Canal de Nemours & Co., Co., Wilmington, North Carolina Delaware; and Sheffield Farm Go., Inc., Norwich, New York. In recent years, the total lactic acid output in the US has increased. It depicts it diagrammatically. Early output numbers were 10,000 pounds in 1894, 400,000 pounds in 1897, and one million pounds in 1917. Commercialization and widespread application Americans and the British invented lactic acid [7]. produce apple juice. There were full apples. A was obtained after 2 hours of therapy with cellulase & pectinase at 50°C.The texture is reduced by 60%. Treatment with enzymes to get clarified juice. The puree is pushed through a tubular membrane system with a single pass. The porous framework of metallic tubes forms a metal oxide membrane. SO-85% juice yield was achieved using only one pass and gas analytical profiles. The ultrafiltered juice tasted like the original apple Pulp. UF's sugar rejection and penetration features the setting is determined by the pipe diameter [8]. This material may be used to make brake discs and turbine blades. Sugar industry transportation includes injection moulds submerged pistons in water supply the pumps, waggons, containers, and equipment. Corrosion experiments were performed using the following rig. Some ASTM G76-95 standard parameters. The rectangular samples had dimensions of 50 25 mm2 and were 3 mm thick. Steel and angular silicon carbides (Sic) were utilised as abrasives. Both have a circular grid with particle sizes ranging from 400 to 420 mm (mesh 60). This allowed the corrosion intensity for each abrasive particle to be compared. Experiments were carried out with four different incidence angles 301, 451, 601, and 901 at a flow speed of 2172.5 g/min with an estimated particle speed of 2472 m/s [9]. Increasing hurdles in the confectionery and starch sectors force businesses to dramatically change Manufacturing processes. As key trends, we may notice the lowering of these processes' environmental effect. Possible alternatives to lime usage to generate process savings, involving liquid and solid wastes discharge Determining prices and value of unwanted by-products. In this regard, this talk will introduce novel innovations that can substitute traditional procedures such as rotational filters, IX resins, centrifuges, and so on. These enable to suggest cost-effective solutions while achieving the objectives outlined above. The following technologies, which have been in use in European plants for some years, will be described: Clarity of diffusion extracts using Sceptre membranes in cross-flow microfiltration. During capital investment Micro filtering can be 50% more expensive than rotary filters, but the operating expenses are twice as low, and the fixed costs are equivalent. Conventional Electrodialysis (ED) is used for demineralization and purification. In comparison to IX Resins, this technique primarily provides for reduced pollution load and increased sugar output. Sugar separation from non-sugars using a better simulated movable bed (ISMB@) technique. This classification Filtration provides greater separation yields while requiring less capital and maintenance costs than typical mimicked city bed chromatography. the industry offered all three processes in European factories. New process additives for sugar or starch production [10]. Rapid burning of lignocellulosic biomass produces less sugar or hydro sugars than pure hydrolysis. Polysaccharides are employed to break pyranose plus furanose circles due to the presence of naturally existing alkali plus alkaline-earth metal (AAEM) enzymes in biomass. Pre-treatment can considerably increase output. Sugar production. Prior to pyrolysis, sulfuric acid is employed to treat biomass, converting it into heat-stable compounds. The role of AAEM throughout the depolymerization the lignin in biomass, on the other hand, is also catalyst dependent. Therefore, inactivating AAEM has unanticipated consequences by reducing lignin depolymerization and volatilization, resulting in an insecure point of touch that limits pyrolysis. Furnaces. To address this issue, numerous non-alkali metal sulphates were investigated as sulfuric acid alternatives. It proved more successful in breaking down lignin without dividing pyranose in the ferrous sulphate form. Rings. The WHSV of conventional air blown combustion of ferrous sulphate was 4 h1, compared to 0.6 h1 for acid pre-treated maize stover. Iron sulphate autothermal (air driven) pyrolysis Pre-treated maize stover improved even more dramatically, raising WHSV from 1 h1 to 10 h1. Under the autothermal process, compared to acid pre-treatment corn stover [11]. arguably the energy procedures in the food or chemical sectors are sugar processing. As a result, membrane separation procedures (MSP) such as microfiltration (MF), ultrafiltration (UF) have a wide range of uses. On that day However, there are several constraints to the application of Ssp in the sugar industry. In comparison, the amounts pushed are extremely large. In other sections of the food business, solutions have a high viscosity and osmotic pressure [12]. Chrome stainless steels are becoming more widely accessible. With extra and comparable features, a potential alternative to the carbon steels utilised in many modern structural applications. Costly requirements to avoid or postpone start-up corrosion when life cycle expenses and environmental compatibility are considered. Their resilience to corrosion and minimal reliant. In comparison to austenitic stainless steels, the cost, usefulness, and durability of Welding of low and high grade ferritic stainless steels has gained a lot of attention for technical applications [13]. Erosion expenses account for a significant portion of sugarcane mill costs in Mauritius. There is currently no study on this topic. As a result, the current investigation was carried out. One among the sugarcane farms in Mauritius that may be used to identify distinct erosion patterns. Oxidation and corrosivity of regularly used metals in corrosive fluids (mostly juices) encountered during the juice extraction procedure. The expense associated with erosion. Degeneracy ultimately adds up. and electrochemical experiments were performed to assess metal corrosion rates in corrosive liquids are compared. The corrosion rates for extract juice from plants and syrup have been determined to have been very high and lower, respectively. Low carbon steel corroded more quickly, but stainless steel 316L rusted more slowly.at the very least Finally, based on the facts The price tag of erosion was calculated to be 6.6% of GDP Manufacturing [14]. Modern improvements in mechanical component design and development have compelled industrialists and engineers to view material selection as a critical activity. Various goods with specialised features and uses are now accessible. Both advantages and disadvantages exist. Material selection for a specific application is a difficult problem for design engineers. Designers are currently being pushed to in the situation of selecting the best material for the design process, the emphasis is on the product's functionality, high productivity, and satisfying client expectations. Inappropriate choice of components can result in machine failure, loss, and even damage to the manufacturing company's reputation. Manufacturers must focus on several material features in the basic exam Material [15].

2. METHODOLOGY

The usage of (MCDM), deterministic techniques, and sets are novel development approaches recently proposed, expanded, and employed by various decision-making academics. There has been no thorough review of the literature or study on the categorization of these techniques. As a result, the current paper tries to give a comprehensive evaluation of methodologies and applications, such as stepwise weight assessments ratio estimation (SWARA) and weighed aggregate evaluation of products (WASPAS), as well as recent confusing advancements in the two latest MCTM applications. In recent years, ambiguous expansions have been considered. In this context, numerous significant databases such as Web of Science, Scopus database were suggested, as well as a comprehensive and meta-analytic technique known as "PRISMA." The authors, year of its release, names of publications and conferences, research aims, research gap and issue, because solution and modelling, and lastly outcomes and findings were used to categorise the selected publications. This study's findings can help decision makers deal with information including stakeholder preferences, interrelated or contradictory criteria, and unpredictable situations. Furthermore, the findings from this research assist practitioners and academics in implementing new MCDM application approaches with names like WASPAS and SWARA in a variety of application fields, as well as providing insight into the available research [16]. The WASPAS approach is a the MCDM method that Zavadskas and colleagues (2012) developed and expanded to several decision-making challenges and settings. Bagos us et al. (2013) introduced a combined multiple-criteria decision-making model based upon the WASPAS technique for selecting the optimal the deep-sea port development location. pointy and Antichain (2013) used AHP, COPRAS, TOPSIS, and WASPAS methodologies to construct an MCDM strategy to deal with the issue of daylighting and cultural continuity in a refurbished local structure. Hashemkhani Zolfani et al. They used methodologies to construct a multi-criteria decision-making methodology to tackle a shopping mall placement dilemma. The durability to the WASPAS & MOORA (Multiple Objective Optimisation Due to Ratio Analysis) approaches was investigated by Javadekar et al. (2013a) [17]. This study proposed the Weighted Whole Product Evaluation (WASPAS) approach, which was based on two WSM model (Weighted Summation Model) and WPM is a (Weighted Product Model), and was used to analyse the negative consequences of project risks. When compared to other ranking independent approaches, this method is efficient and accurate. The WASPAS approach is a recent multi-indicator decision-making tool that has been adopted and applied in a variety of settings. We identified and assessed the risks of a project to build roads in Iran in this study, and concluded that the most significant risks were inaccessibility/inappropriateness of the baroque holes, loss of key labour during the project life cycle, as well as hiring of inexperienced subcontractors. Furthermore, this article proposed the WASPAS approach as an accurate MCDM strategy for assessing hazards in a real-world context [18]. The goal of this work is to create a method for choosing projects to improve processes which makes it possible for project prioritisation while managing unpredictability and the dynamic nature of evaluations linked to various major continuous improvement criteria. The current study chose a multi-criteria decision-making method—weighted aggregate product evaluation (WASPAS)—that employs ordered uncertain numbers (OFNs), which is an extension of Zadeh's fuzzy set technique [19]. As a result, this choice is a method known as (multi-criteria decision-making) conundrum. In this work, a novel Integrative Decision-Making Approach (CRITIC) and Weight Aggregate Products Assessment (WASPAS) technique is used to solve a private hospital's time and attendance system choice problem. The CRITIC approach determines the importance of the criteria, and the WASPAS method ranks the options to identify the best option. The CRITIC & WASPAS methodologies are combined at the first time within the literature in this paper [20]. The recently established Generalised Average Product Assessment (WASPAS) technique is recommended by current research (Zavadskas et al. 2012). WASPAS optimises the weighted aggregated function using a suggested strategy to get the best estimation accuracy. When deciding on the best techniques for building in2013 and housing renovation, a good retail mall site is crucial [21]. WASPAS represents a new MADM strategy that is gaining traction in the MADM framework literature. Aside from its ease of use, the WASPAS technique employs the notion of ranking correctness by integrating the commonly used WSM and WPM. This combination, realised through an optimisation criterion, provides new options for assessing confidence intervals for alternative relative importance and minimising the predicted variance of ranking outcomes. Despite its relevance, the coupling some methods in the literature is frequently done on a case-by-case basis. All relevant formulae are re-derived in this work, and necessary adjustments are presented with explicit examples [22]. The selection of a building site is a complicated issue owing to the existence of several physical and intangible aspects as well as numerous possibilities. Multi criteria methods for decision-making (MCDM) offer effective and adaptable solutions to numerous environmental issues. In this study, we present WASPAS-SVNS, an updated version of the WASPAS approach. This expansion is realised within the context of a single-valued neutrosophic set, which allows for explicit representation and modelling of instability [23] Paper Factors The article addresses the challenge of locating a waste incineration facility owing to regulations. To tackle multi-criteria decision-making issues using reluctant fuzzy information, an integrated technique centred on the Weighing Aggregated Product Assessment (WASPAS) methodology is created. This technique relies on non-hesitant fuzz operators, which are an improvement over the traditional WASPAS methodology and the mechanism for determining criteria weights. We offer new data measures for uncertain sets and mix entropy and dissimilarity metrics for guideline weights, while employing a similarity measure for judgement specialist weights to calculate guideline and decision experts' weights [24]. In this paper, we attempt to propose a system for the future development of Iran's high-tech sectors. The SWARA-WASPAS approach is used for making decisions and long-term planning. Because nanotechnology has made significant development in Iran, the sector under consideration is the nanoscale sector. To that end, all applications on nanotechnology across multiple scientific domains in Iran were recognised and judged using criteria derived from a survey of the literature and previous research. WASPAS is the tool for assessing criteria and alternatives. The goal is to come up with priority uses of nanotechnology [25].

Alternative parameters

J4: J4, often simply known as "J4 pure steel", is a grade of stainless steel. It is a ferritic stainless steel that is distinguished by its substantial chromium concentration and low carbon content. The J4 grade is corrosion resistant, making it suited for use in a range of sectors such as kitchenware, car trim, and architectural components. It is formable and weldable, making it simple to shape and connect. Also, J4 stainless steel is less expensive than other shiny steel grades due to its low alloying components, making it an appealing alternative for producers seeking efficiency and cost.

JSLAUS: The abbreviation for "Jindal Steel Limited Austenitic Carbon Steel" is JSLAUS. It is a kind of stainless steel that is created by Jindal Stainless Private Limited, India's largest producer. JSLAUS is an austenitic steel that has been noted for its good corrosive property, high ductility & low magnetic permeability. This stainless-steel type is often used in applications that need great resistance to chemicals, acids, and high temperatures, such as the chemical, food, and pharmaceutical sectors. JSLAUS has high weldability and formability, making fabrication and customisation simple. JSLAUS, in collaboration with Jindal Stainless Limited, delivers dependable and high-quality stainless-steel products suitable for a variety of industrial applications.

204Cu: 204Cu is a stainless steel that is a member of the austenitic, or stainless steel, family. It is distinguished in its composition, which consists of around 16-17% chromium, 4-6% nickel, and a substantial amount of copper. The inclusion of copper enhances the steel's corrosion resistance and formability. 204Cu stainless steel is often used in applications requiring high corrosion resistance and low cost, which include kitchenware, devices, and automotive components. This standard provides a good combination of performance and cost, making it a good choice for a range of sectors. The presence in copper gives the steel's surface a characteristic red colour.

409 M: 409M is a stainless-steel grade that belongs within the ferrous stainless-steel family. It has a good resistance to corrosion particularly under high temperature conditions. The letter "M" in 409 M stands for its modification, which incorporates titanium and niobium. These metals contribute to increased weldability and intergranular corrosion resistance in steel. 409 M steel is frequently employed in exhaust networks, automotive components, and other use cases that need heat and exhaust gas resistance. Its great temperature stability, paired with its low cost, makes it a preferred choice in industries with significant thermal and corrosive strains.

AISI 304: The American Steel and Steel Inspectorate (AISI) 300 series stainless steel grade AISI 304 is frequently used. It is a mixed austenitic steel, which is noted for its exceptional corrosion and flexibility. AISI 304 has a chromium content of 18% and or sometime it may reach up to 20% a nickel content of 8 to 10.5%, which gives high resistance to oxidation, chemicals, and air corrosion. Because of its sanitary features, simplicity of manufacture, and aesthetic appeal, this grade is widely employed in a range of sectors, including processing of food, chemical equipment, and architectural applications. AISI 304 is one of the most extensively used stainless steel grades in the world due to its combination of mechanical strength, formability, and cost-effectiveness.

Evaluation parameters

Yield strength: The yield value is a physical parameter that determines the stress amount at which an object begins to irreversibly deform, or "yield," without experiencing considerable strain rise. It denotes the maximum stress that a material can endure before deforming plastically. Yield strength is a critical design and engineering characteristic since it determines an item's load bearing capability and structural integrity. Tensile testing is commonly used to quantify it, in which the stress of the material is steadily raised until yielding occurs. Yield strength is a key factor in several sectors, including construction, manufacturing, and aviation.

Ultimate tensile strength: Ultimate tensile load (UTS) is an elasticity parameter that specifies how much stress an element can bear before it breaks or cracks. During a tensile examination, it is the most stressed point on the curve of stress-strain where the material encounters its maximum load. The capacity of a material to withstand external pressures is referred to as its UTS, and it is significant for determining structural integrity and longevity. It is commonly used in the manufacturing and engineering industries to assess a material's appropriateness for specific uses such as structures, automotive parts, or aeronautical equipment. Higher UTS values usually imply stronger materials that can tolerate larger pressures and stresses.

Hardness: The resistance of a substance to deformation, indentation, or corrosion is measured by its hardness. It is the capacity of a substance to endure external pressures & resist surface penetration. Hardness is often assessed using several methods such as the Brinell, Rockwell, or Vickers levels, which entail applying a force or load to the material's surface to form an indentation. The hardness rating indicates the substance's strength, wear resistance, and adaptability for various applications. Hardness is frequently used in metallurgy, technology, and manufacturing to measure the resilience and efficiency of materials under varied operating circumstances. In general, higher hardness levels suggest greater strength and greater wear-resistant materials

% Of elongation: The percentage of elongation of a material is a mechanical parameter that indicates the amount of distortion it goes through before breaking. It is calculated through gauging the change in the dimension of a specimen following a tensile test. % Elongation is a material's capacity to expand or stretch beneath tensile tension before breaking. This gives an understanding of the material's ductility and flexibility, since higher elongation values suggest a greater capacity to endure deformation without failure. This metric is significant in industries wherein materials are subjected to dynamic or recurrent shipment, as well as such as construction, automotive, and manufacturing, since it assesses the capacity of the material to sustain stretching or bend without fracture.

Cost: The amount of money associated with getting products, services, or resources is referred to as cost. Production expenses, labour, raw materials, transportation, overheads, and profit margins are all included. Understanding and controlling expenses is critical for a company's profitability or financial sustainability. Estimating and optimising expenses to achieve cost effectiveness and competitiveness is what cost analysis entails. It is crucial in decision-making processes such as pricing strategies, budgeting, and resource allocation. Cost issues are important in a wide range of sectors from manufacturing to building to facilities and retail, as businesses strive to manage costs while providing value to customers.

Wear rate: The amount of materials loss or degradation that happens gradually due to abrasion, scratches, or other wear processes is referred to as depreciation. It is often represented in terms of mass or volume lost per minute of travel distance or time. Abrasion is a critical factor in determining the stability and efficiency of substances in attraction and contact activities. A low wear rate suggests stronger wear resistance and a longer material life. Understanding and regulating wear rates is crucial in sectors where part and surface are hit with repetitive contacting and sliding motions, such as automotive, production, and mining. Accurate wear rate measurement and analysis may enhance material selection, lubrication, and design, reducing wear and increasing product dependability.

3. Result and discussion

TABLE 1. Piping materials and its properties

	Yield strength	Ultimate tensile strength	Hardness	% Of elongation	Cost	Wear rate
J4	382	728	98	48	112	2.75
JSLAUS	420	790	97	58	210	2.63
204Cu	415	795	96	55	120	2.5
409 M	270	455	78	32	184	4
AISI 304	256	610	86	60	89	2.59

Table 1 shows the different types of piping materials and its properties.

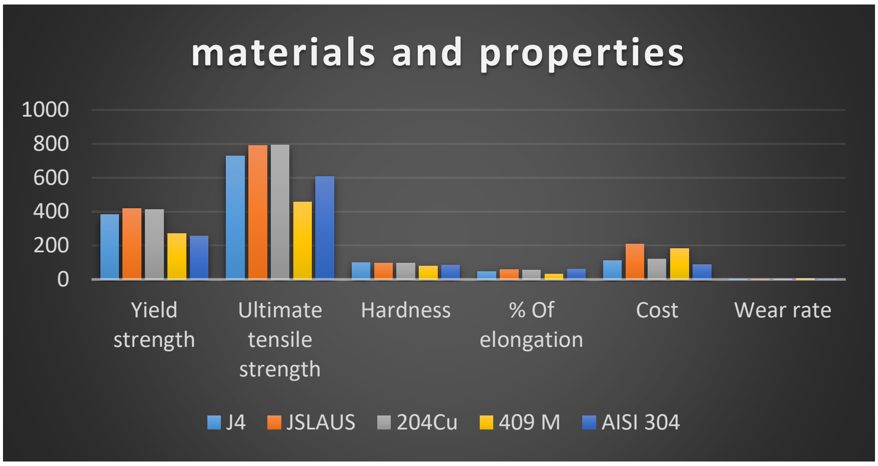

FIGURE 1. graph of levels of evaluation properties

Figure 1 shows the graph of alternate and evaluation parameters of the materials. The alternative parameters are J4, JSLAUS, 204Cu, 409 M, AISI 304.

TABLE 2. Normalized Matrix

normalized matrix					
0.909524	1.733333	0.233333	0.666667	0.285714	11.63636
1	1.880952	0.230952	0.551724	0.152381	12.1673
0.988095	1.892857	0.228571	0.581818	0.266667	12.8
0.642857	1.083333	0.185714	1	0.173913	8
0.609524	1.452381	0.204762	0.533333	0.359551	12.35521

Table 2 shows the normalized matrix using the WASPAS method

TABLE 3. Weighted matrix

weighted matrix					
0.16	0.16	0.16	0.16	0.16	0.16
0.16	0.16	0.16	0.16	0.16	0.16
0.16	0.16	0.16	0.16	0.16	0.16
0.16	0.16	0.16	0.16	0.16	0.16
0.16	0.16	0.16	0.16	0.16	0.16

Table 2. shows the weighted matrix. the weighted matrix is nothing but sum of the value of the column is 1.

TABLE 4. weighted normalized matrix (WSM)

weighted normalized matrix (WSM)					
0.145524	0.277333	0.037333	0.106667	0.045714	1.861818
0.16	0.300952	0.036952	0.088276	0.024381	1.946768
0.158095	0.302857	0.036571	0.093091	0.042667	2.048
0.102857	0.173333	0.029714	0.16	0.027826	1.28
0.097524	0.232381	0.032762	0.085333	0.057528	1.976834

$$w_{ij} = w_i n_{ij}$$

TABLE 5. weighted normalized matrix (WPM)

weighted normalized matrix (wpm)					
0.984941	1.091996	0.792276	0.937185	0.818369	1.480917
1	1.10637	0.790977	0.909234	0.740063	1.491527
0.998086	1.107488	0.789666	0.916993	0.809385	1.503674
0.931748	1.012889	0.763863	1	0.755881	1.394744
0.923844	1.061532	0.775889	0.904315	0.849027	1.495189

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In table 5 We derived the weighted normalized matrix by using WOM method. It is derived by normalized matrix to the power of weighted matrix value.

TABLE 6. Preference Value (WSM, WPM)

Material	preference value (WSM)	preference value (WPM)
J4	2.47439	0.967861
JSLAUS	2.55733	0.878293
204Cu	2.681281	0.974148
409 M	1.773731	0.760017
AISI 304	2.482362	0.873512

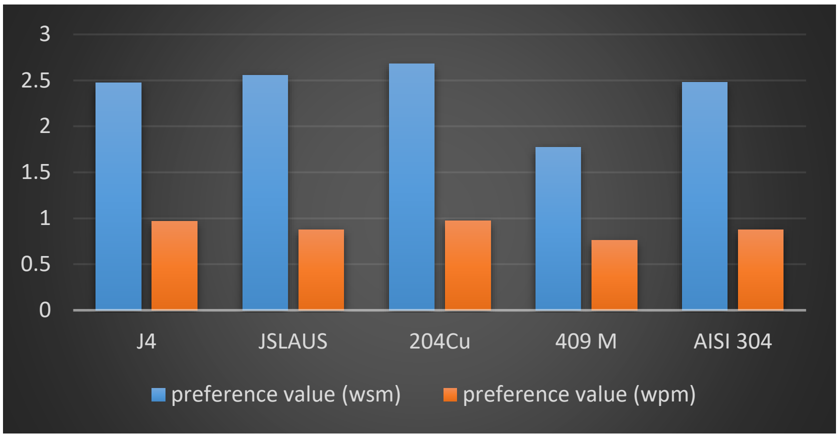

FIGURE 2. preference value (WSM, WPM)

Preference score for the given alternative, based on WSM, is calculated by $S_i^{WSM} = \sum_{j=1}^{n} w_j n_{ij}$

Preference score for the given alternative, based on WSM, is calculated by $S_i^{WPM} = \prod_{j=1}^{n} (n_{ij})^{w_j}$

Table 7. WASPAS coefficient

lamda	Material	WASPAS coefficient
0.5	J4	1.721125
	JSLAUS	0.878293
	204Cu	0.974148
	409 M	0.760017
	AISI 304	0.873512

Table 7. illustrates the WASPAS coefficient. it is obtained by $S_i^{WASPAS} = \lambda\, S_i^{WSM} + (1-\lambda\,)S_i^{WPM}$

$S_i^{WASPAS} = \lambda \sum_{j=1}^{n} w_j n_{ij} + (1-\lambda\,) \prod_{j=1}^{n} (n_{ij})^{w_j}$, where λ is between 0 and 1. Here we have taken as 0.5.

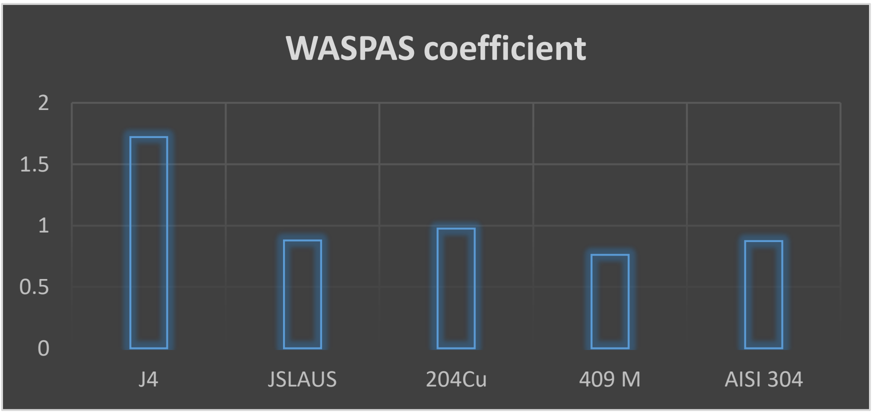

FIGURE 3. WASPAS coefficient

Table 8. Rank

Material	RANK
J4	1
JSLAUS	3
204Cu	2
409 M	5
AISI 304	4

The table 8. Gives the rank of the material by evaluation parameters. J4 in 1st rank, JSLAUS in 3rd rank, 204Cu in 2nd rank, 409 M in 5th rank, AISI 304 in 4th rank.

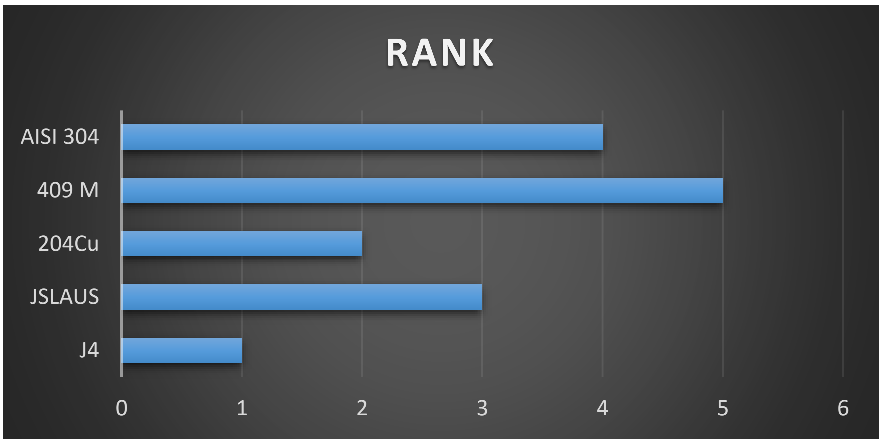

FIGURE 4. Rank

Figure 4 graph shows the rank of the different alternative parameters. J4 in 1st rank, JSLAUS in 3rd rank, 204Cu in 2nd rank, 409 M in 5th rank, AISI 304 in 4th rank.

4. CONCLUSION

Multi-criteria making decisions (MCTM), deterministic methodologies, and fuzzy sets are current development approaches suggested, expanded, and applied by many decision-making academics. There is no comprehensive evaluation of the literature or classification of these procedures. As a result, the current paper aims to provide a thorough evaluation of techniques and applications that include Stepwise weighting. Inspections The proportion Testing (SWARA) and weighting. It Assessment for the items (WASPAS), in addition to current disorganised improvements in two current MCTM applications. Vague expansions have been discussed in recent years. Several important databases, including Web of Science, Scopus, and Google Scholar, were recommended in this context, plus a comprehensive integrative meta-analytical approach known as "PRISMA. “To classify the selected articles, the writers, the year of the publication, title of articles and conferences, technique and method utilised, research aims, research gap and issue, because solution and modelling, and ultimately results and findings as used. This study's findings can assist decision makers in dealing with information such as stakeholder preferences, connected or competing criteria, and unanticipated events. Furthermore, the outcomes of this study help practitioners and academics adopt new MCDM application techniques with names like WASPAS and SWARA in a variety of application sectors, as well as providing insight into existing research. Steel pipes are a vital element in the sugar manufacturing business, offering several advantages that help to efficient and sanitary operations. Because of their corrosion resistance, great strength, and longevity, they are perfect for conveying corrosive sugar solutions while preserving product purity. The smooth interior surface on stainless steel pipes inhibits deposits and bacterial development, maintaining the sugar product's integrity. Furthermore, using WASPAS (Weighted Aggregated Product Evaluation) approach may be used to evaluate and rank stainless steel pipe options based on a range of characteristics such as expenses, corrosion resistance, maintenance needs, and durability.

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