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Model development of Coating Material for Low Carbon Steels using Multi Criteria Decision Making Techniques

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Abstract

Fluid handling equipment such as propellers, impellers, pumps, and pumps in warships and submarines all suffer from flow-based erosion-corrosion concerns. While numerous coating materials are available to counteract erosion corrosion damage in the aforesaid components, iron-based amorphous coatings are thought to be more effective. This paper concentrates on the selection of the coating material for AISI 304L SS. In this investigation, WC-10Co-4Cr coating was developed on stainless steel substrate using MCDM techniques. Fuzzy analytic hierarchy process (FAHP) is the technique applied to calculate the weights of Criteria and Combinative Distance-Based Assessment Method (CODAS) is utilised for ranking the Alternatives.

Keywords: Erosion-corrosion; Fuzzy Analytic Hierarchy Process (FAHP); MCDM; CODAS; Weight; AISI 304L SS; Coating material; Substrate.

Introduction

Utilization and materials decision are main issues of interest in the practical arrangement and movement of power plant, substance plant, pipeline transport and wells. These all construction a piece of Carbon Dioxide catch and limit (CCS) systems. To pick materials it is pivotal for first know the all-out stream manifestations and the full extent of working conditions to which all equipment will be exposed. All critical things of stuff were depicted and all bits of the cycle impacted by extension of CCS were recognized. The conditions for transport pipelines and mixture wells were also portrayed by their work. [1]

Significant disappointments have happened in channeling because of single-stage or wet-steam disintegration erosion, bringing about wounds or death toll just as broad plant vacation. Both atomic and fossil force plants just as petrochemical plants are helpless to disintegration erosion. Causes, conceivable restorative activities, where to glance in helpless frameworks, ideal nondestructive assessments and scientific methods to anticipate remaining life are covered. Variables relieving disintegration consumption which are heavily influenced by the plant proprietor are the pH (>9.0 is ideal), oxygen content (50ppb), and pipe material (a 2.25Cr-1Mo steel is extremely impervious to single-stage disintegration erosion while austenitic are impervious to wet steam).

Single-stage disintegration erosion is probably going to happen in least stream distribution lines, downstream of stream control valves (point valves specifically) and in elbows in closeness to different fittings. Occasions of single-stage disintegration consumption have been accounted for in different fittings, for example, at the little distance across end of a diffuser, and so forth Disintegration erosion is brought about by a convoluted exchange of various boundaries. An enormous assortment of test work has recognized a few key factors that impact the pace of assault.

Huge factors incorporate temperature of water or steam, pH, oxygen content of liquid, nature of steam, stream speed, nature of oxide layer on internal surface of the line, and synthetic arrangement of the steel pipe. Common powerless frameworks are feed water and let-down lines in water and elbows, tees, and so forth, in wet steam. Different frameworks working under tantamount conditions additionally are helpless to assault. [2]

Disintegration erosion (E-C) is a sped up type of assault brought about by the evacuation or breakdown of defensive surface movies because of the progressio n of the cooling water. Impingement assault and cavitation erosion are additionally types of E-C.

Horseshoe impingement assault is brought about by over the top disturbance, as a rule close to the gulf of the cylinders; the assault, looks like pitting and is disseminated looking like a horseshoe. Entrained air pockets and sand particles in water worsen the assault. This type of E-C is generally predominant in copper-base compounds, especially brasses. Copper-nickel composites containing iron or chromium augmentations are moderately safer; while treated steels and titanium are invulnerable to this type of assault.

The inactive movies on titanium and on nickel-chromium-molybdenum compounds are exceptionally safe to assault by Cl- particles, though the aloof movies on hardened steels and on other nickel-base amalgams are defenceless to Cl- infiltration, particularly under stale (like fissure) and low water speed conditions. The movies framed on copper compounds in seawater fuse Cl- particles, these movies are not stringently latent flimsy oxide films like those on titanium and on tempered steels. The movies on copper amalgams are effortlessly assaulted by high speed seawater. Then again, at low speeds these movies offer great security.

The austenitic treated steel is the most generally utilized composite in various modern applications, for example, engineering, mining, science, metallurgy, and marine gear and foundation. Alongside the greatness of composite openness to ecological conditions, there are many situations where forceful media are multiphase in nature as they comprise of water, air, and strong particles of various sizes. Specifically, in the mining business, because of their high protection from erosion, moderate expense, and mechanical execution, treated steel has been widely utilized. Undoubtedly, the austenitic treated steel type 304L is utilized in pipes, siphons, compartments, or different segments like nuts or fasteners. The presence of chromium and nickel in these prepares further develops extensively its consumption opposition, because of the suddenly shaped uninvolved film on its surface. Be that as it may, this aloof film can be firmly destabilized beginning its disappointment or breakdown that starts a restricted erosion interaction, for example, pitting erosion within the sight of slurries, pitting consumption can be expanded because of synergistic collaboration with strong particles that encroach upon the metal surface. The erosion rate and detached film breakdown have been widely concentrated in austenitic tempered steel covering circumstances when this material is likewise exposed to mechanical harm from strong particles which is depicted as a disintegration erosion wonder. Several coating techniques are currently used to study E-C. Zimmerman (2001) proposed Fuzzy sets to demonstrate vulnerability.

HVOF innovation has acquired a lot of consideration in the covering groundwork for as far back as couple of a long time as it can create coatings with better caliber and sets up great attachment with the substrate. To track down the appropriate covering material for the substrate, incorporated Fuzzy Analytic Hierarchy Process-Combinative Distance – Based Assessment Method (FAHP-CODAS) technique was utilized.

Fuzzy Composition

In the event that A has a fuzzy connection from X to Y and B from Y to Z individually, the arrangement of A and B is a Fuzzy connection that is depicted as

μAoB (xi, zk) = max (min (μA (xi, yj), μB (yj, z and k))).

There are three boundaries 'a' (min), 'b' (mid) and 'c' (max) for the three-sided work addressed by x (a, b, c) and has 4 boundaries and ' a ' (min), ' b '& ' c ' (fundamentals) and'd ' (max) for the trapezoidal capacity addressed by x(a, b, c, d) . Fuzzy membership is shown in Figure 1.

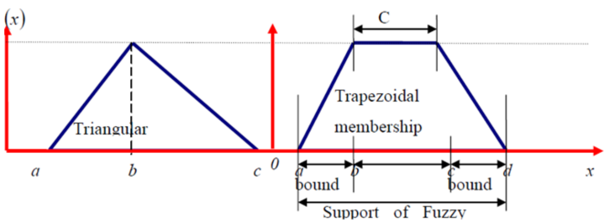

Figure1: Typical fuzzy membership and properties.

In multicriteria decision aid, crisp values are insufficient to describe real-life circumstances, and imprecise notions are typically represented. When dealing with ambiguity data, intuitionistic fuzzy set theory promises success. Furthermore, involving a group of decision-makers in the decision-making process can be advantageous for picking the best option and avoiding project failures. Keshavarz Ghorabaee et al. proposed the (CODAS) [approach (2016). It has various characteristics that aren't taken into account by the other MCDM approaches. It uses the Euclidean distance as the key criterion for determining the acceptability of an alternative. When two options' Euclidean distances are relatively close, the Taxicab distance is used to compare them. The CODAS approach is described in depth in this paper, along with a numerical example.

Methodology

In 304 L SS , the seriousness of the harm brought about by electrochemical, compound, and mechanical impacts is of more prominent significance for a few modern areas, where their effect is reflected in both specialized viewpoints and monetary perspectives. Regularly, disintegration erosion wonder is the most well-known corruption instruments present in all field of works. Therefore, in this work, we track down an appropriate a reasonable covering material for the wear and disintegration erosion conduct of treated steel AISI 304L [5]. Since improvement of suitable covering material has a place with MCDM class, an incorporated Fuzzy AHP-CODAS has been embraced in this work. CODAS is a very efficient tool in ranking the alternatives in MCDM problems. It gives better results with Fuzzy AHP.In this method, Criteria Weights are calculated by using fuzzy AHP and coating materials are ranked using CODAS. The steps involved are shown in Figure 2.

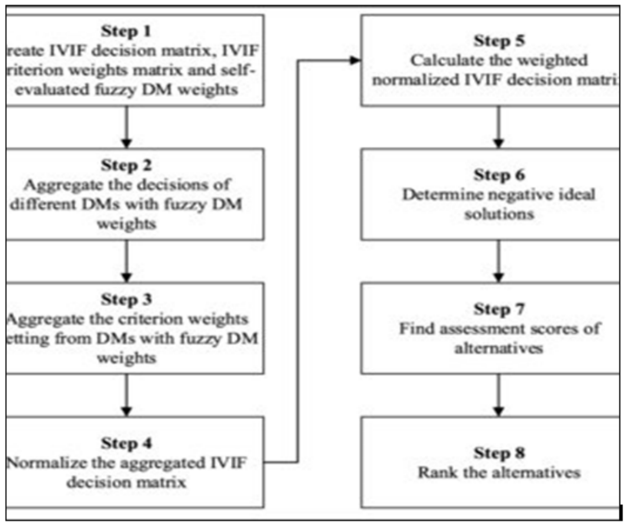

Figure2: Steps in model development using Fuzzy AHP-CODAS integration.

As per Ibrahim Ahmed Badi et.al, the following phases were used in this study

Phase 1

Potential alternatives, and criteria are identified in FAHP by taking into consideration both literature survey and expert opinion. The integrated fuzzy set theory is then used to build these criteria hierarchically and convert the opinions of decision makers allocated to each criterion to a precise value. Fuzzy Weight vectors of each criterion were also calculated.

Phase 2

In CODAS, Negative Ideal Solution points were calculated from the Weighted Normalized Decision Matrix. Then finally ranking of alternatives has been done using the Relative assessment score matrix generated with the help of both Euclidean distance and Taxicab distance.

The proposed methodology is used in my work to address erosion corrosion issues. The issue is determining which coating material is suitable for AISI 304 L stainless steel. The following features connected to the coating substrate system should be considered when deciding on the optimal coating material from the available options [3, 4]

- Coating adhesion
- Internal stress assessment
- Wear resistance assessment
- A literature review identified a number of characteristics.

The problem is then solved using the Fuzzy AHP –CODAS Integration technique.

Fuzzy AHP steps in Process1

The steps in this procedure are as follows

Obtaining the Fuzzy Judgement Matrix (Step 1)

A survey was done by distributing questionnaires to several industries, Alternatives and criteria were created based on their collective opinion as well as literature surveys.

Selected Criteria details are tabulated below [5, 6]

Table1: Coating material criteria.

Selected Criteria	**Reason for selection**
H3/E2 ratio (R)	A non-beneficial criterion, whose value should be minimised for less wear
Density(D)	The value should be minimum for effective coating
Adhesive Bonding (AB)	High base-deposition bonding must be ensured
Yield Strength(YS)	A beneficial criteria for coating process
Cost(C)	Material and manufacturing cost should be effective according to the operating conditions
Thermal Conductivity(TC)	The value should be minimum to achieve better coating deposition

Determination of Fuzzy Judgment Score with respect to each criterion is tabulated in Table 2, Table 3, and Table 4 respectively. [7]

Table2: The Sub scores of all candidates with respect to all criteria.

Coating Selection Criteria	**316L SS**	**WC-Cr3C2-Ni**	**WC-10 Co-4Cr**	**Stellite 6**	**70Ni30 Cr**	**Al2O3-TiO2**
H3/E2 ratio (R)	4	4	3	2	4	8
Density(D)	6	4	3	3	6	6
Adhesive Bonding (AB)	4	7	2	6	4	9
Yield Strength(YS)	7	4	4	5	3	5
Cost(C)	4	2	2	8	4	4
Thermal Conductivity(TC)	5	6	2	6	6	8

Table3: Rating of each coating material with respect to all Criteria.

Coating Selection Criteria	**316L SS**	**WC-Cr3C2-Ni**	**WC-10 Co-4Cr**	**Stellite 6**	**70Ni30 Cr**	**Al2O3-TiO2**
H3/E2 ratio (R)	(2,4,6)	(2,4,6)	(1,3,5)	(1,2,4)	(2,4,6)	(6,8,9)
Density(D)	(4,6,8)	(2,4,6)	(1,3,5)	(1,3,5)	(4,6,8)	(4,6,8)
Adhesive Bonding (AB)	(2,4,6)	(5,7,9)	(1,2,4)	(4,6,8)	(2,4,6)	(7,9,9)
Yield Strength(YS)	(5,7,9)	(2,4,6)	(2,4,6)	(3,5,7)	(1,3,5)	(3,5,7)
Cost(C)	(2,4,6)	(1,2,4)	(1,2,4)	(6,8,9)	(2,4,6)	(2,4,6)
Thermal Conductivity(TC)	(3,5,7)	(4,6,8)	(1,2,4)	(4,6,8)	(4,6,8)	(6,8,9)

Table4: The fuzzy judgment scores of each Coating Material relating to each criterion.

Coating Selection Criteria	**316L SS**	**WC-Cr3C2-Ni**	**WC-10 Co-4Cr**	**Stellite 6**	**70Ni30 Cr**	**Al2O3-TiO2**
H3/E2 ratio (R)	(0.13,0.36,0.85)	(0.13,0.36,0.85)	(0.07,0.27,0.71)	(0.07,0.18,0.57)	(0.13,0.36,0.85)	(0.40,0.72,1.27)
Density(D)	(0.24,0.50,0.81)	(0.12,0.34,0.61)	(0.06,0.25,0.51)	(0.06,0.25,0.51)	(0.24,0.50,0.81)	(0.24,0.50,0.81)
Adhesive Bonding (AB)	(0.11,0.28,0.60)	(0.28,0.49,0.90)	(0.06,0.14,0.40)	(0.23,0.42,0.80)	(0.11,0.28,0.60)	(0.40,0.63,0.90)
Yield Strength(YS)	(0.30,0.59,1.25)	(0.12,0.34,0.83)	(0.12,0.34,0.83)	(0.18,0.42,0.97)	(0.06,0.25,0.69)	(0.18,0.42,0.97)

Cost(C)	(0.13,0.37,0.85)	(0.07,0.18,0.57)	(0.07,0.18,0.57)	(0.40,0.73,1.27)	(0.13,0.37,0.85)	(0.13,0.37,0.85)
Thermal Conductivity (TC)	(0.16,0.35,0.72)	(0.22,0.42,0.83)	(0.05,0.14,0.41)	(0.22,0.42,0.83)	(0.22,0.42,0.83)	(0.33,0.56,0.93)

Criteria Weight Computation (Step 2)

The weight vectors of each criterion were calculated using FAHP using a pairwise comparison matrix with the help of three decision makers. The following tables list the results of the computations:

Table5: Pair wise Comparison Matrix-1.

Coating Selection Criteria	R	D	AB	YS	C	TC
H3/E2 ratio (R)	1	1/3	1/5	1/7	1/2	1/4
Density(D)	3	1	1/6	1/3	1/5	1/7
Adhesive Bonding (AB)	5	6	1	1/5	1/3	1/2
Yield Strength(YS)	7	3	5	1	1/5	1/2
Cost(C)	2	5	3	5	1	1/3
Thermal Conductivity(TC)	4	7	2	2	3	1

Table6: Pair wise Comparison Matrix-II.

Coating Selection Criteria	R	D	AB	YS	C	TC
H3/E2 ratio (R)	1	1/7	1/3	1/2	1/3	1/6
Density(D)	7	1	1/2	1/6	1/4	1/3
Adhesive Bonding (AB)	3	2	1	1/4	1/6	1/3
Yield Strength(YS)	2	6	4	1	1/4	1/7
Cost(C)	3	4	6	4	1	1/5
Thermal Conductivity(TC)	6	3	3	7	5	1

Table7: Pair wise Comparison Matrix-III.

Coating Selection Criteria	R	D	AB	YS	C	TC
H3/E2 ratio (R)	1	1/3	1/6	1/2	1/4	1/5
Density(D)	3	1	1/2	1/5	1/4	1/3
Adhesive Bonding (AB)	6	2	1	1/3	1/6	1/3
Yield Strength(YS)	2	5	3	1	1/6	1/7
Cost(C)	4	4	6	6	1	1/4
Thermal Conductivity(TC)	5	3	3	7	4	1

Table8: Comprehensive Pair Wise Comparison Matrix.

Coating Selection Criteria	H3/E2 ratio (R)	Density (D)	Adhesive Bonding (AB)	Yield Strength (YS)	Cost(C)	Thermal Conductivity(TC)
H3/E2 ratio (R)	(1,1,1)	(0.14,0.27,0.33)	(0.17,0.23,0.33)	(0.14,0.38,0.5)	(0.25,0.36,0.5)	(0.17,0.21,0.25)
Density(D)	(3,4.3,7)	(1,1,1)	(0.17,0.39,0.5)	(0.17,0.23,0.33)	(0.2,0.23,0.25)	(0.14,0.27,0.33)
Adhesive Bonding (AB)	(3,4.67,6)	(2,3.33,6)	(1,1,1)	(0.2,0.26,0.33)	(0.17,0.22,0.33)	(0.33,0.39,0.5)
Yield Strength(YS)	(2,3.67,7)	(3,4.67,6)	(3,4,5)	(1,1,1)	(.17,.21,.25)	(0.14,.26,.5)

Cost(C)	(2,3,4)	(4,4.33,5)	(3,5,6)	(4,5,6)	(1,1,1)	(.2,.26,.33)
Thermal Conductivity (TC)	(4,5,6)	(3,4.33,7)	(2,2.33,3)	(2,5.3,7)	(1,1,1)	(3,4,5)

Fuzzy Weights for each criterion was calculated and the obtained values are:-

- H3/E2 ratio (R) = (0.02, 0.03, 0.06)
- Density (D) = (0.5, 0.9, 0.18)
- Adhesive Bonding (AB) = (0.7, 0.14, 0.27)
- Yield Strength (YS) = (0.10, 0.19, 0.38)
- Cost(C) = (0.15, 0.25, 0.43)
- Thermal Conductivity (TC) = (0.15, 0.30, 0.56)

CODAS STEP OF PROCESS 2 [8]

Creation of decision matrix (Step 1)

The fuzzy performance matrix is created by combining the fuzzy judgement score of each alternative with the Weight Vector. After that, the fuzzy values are turned to crisp values. The decision matrix is obtained after defuzzification, as shown in the table below:

Table9: Decision Matrix.

Coating Selection Criteria	316L SS	WC-Cr3C2-Ni	WC-10 Co-4Cr	Stellite 6	70Ni30 Cr	Al2O3-TiO2
H3/E2 ratio (R)	0.0161	0.0161	0.0125	0.009	0.0161	0.0293
Density(D)	0.0553	0.0389	0.0299	0.0299	0.0553	0.0553
Adhesive Bonding (AB)	0.0521	0.0864	0.0293	0.0749	0.0521	0.1027
Yield Strength(YS)	0.1528	0.0929	0.0929	0.1124	0.0719	0.1124
Cost(C)	0.1246	0.0687	0.0687	0.2253	0.1246	0.1246
Thermal Conductivity(TC)	0.1385	0.1641	0.0635	0.1641	0.1641	0.207

Identification of max-min values (Step 2)

From the evaluation matrix, select the beneficial and the non-beneficial criteria. From the obtained matrix, Adhesive Bonding (AB) and Yield Strength (YS) were identified as the beneficial criteria while H3/E2 ratio (R), Density (D), Cost(C) and Thermal Conductivity (TC) were found to be the non-beneficial criteria. The Max-min values were then calculated and are tabulated as below:

Table10: Decision Matrix with beneficial and non-beneficial criteria.

Criteria	H3/E2 ratio (R)	Density (D)	Adhesive Bonding (AB)	Yield Strength (YS)	Cost(C)	Thermal Conductivity (TC)
316L SS	0.0099	0.0395	0.0467	0.1422	0.0783	0.0992
WC-Cr3C2-Ni	0.0155	0.0395	0.1048	0.1206	0.0783	0.1643
WC-10 Co-4Cr	0.0071	0.018	0.0323	0.0395	0.054	0.025
Stellite 6	0.0099	0.0323	0.0992	0.1422	0.1974	0.1643
70Ni30 Cr	0.0099	0.0395	0.0467	0.0562	0.0783	0.1209
Al2O3-TiO2	0.0251	0.054	0.1048	0.1422	0.1223	0.1643
Beneficial/ Non-beneficial	Non-beneficial	Non-beneficial	Beneficial	Beneficial	Non-beneficial	Non-beneficial
Max-min value	0.0071	0.018	0.1048	0.1422	0.054	0.025

Normalization of the decision matrix (step 3)

Calculate the normalized decision matrix. Linear normalization of performance values is used as given by equations (1) & (2) for beneficial criteria & non-beneficial criteria respectively

$$n_{ij}=X_{ij}/\text{Max-min value}$$

$$n_{ij}=\text{Max-min value}/X_{ij}$$

Eqaution 1&2.

Table11: Normalized Decision Matrix (nij).

Criteria	R	D	AB	YS	C	TC
316L SS	0.7232	0.4542	0.4456	1	0.6897	0.2522
WC-Cr3C2-Ni	0.4616	0.4542	1	0.8483	0.6897	0.1523
WC-10 Co-4Cr	1	1	0.3081	0.2779	1	1
Stellite 6	0.7232	0.5562	0.9469	1	0.2737	0.1523
70Ni30 Cr	0.7232	0.4542	0.4456	0.3954	0.6897	0.207

Al2O3-TiO2	0.2843	0.3323	1	1	0.4417	0.1523

Defuzzification of fuzzy weight vectors (Step4)

The fuzzy weight vectors of each criterion was converted to crispy values and are shown below:

Table12: Defuzzified criteria weight.

Criteria	crisp values
H3/E2 ratio (R)	0.0362
Density(D)	0.0996
Adhesive Bonding (AB)	0.1535
Yield Strength(YS)	0.2101
Cost(C)	0.2686
Thermal Conductivity(TC)	0.3267

Weighted normalized decision matrix (Step 5)

Calculate the weighted normalized decision matrix. The weighted normalized performance values are calculated as given by equation (3).

$$r_{ij}=w_j n_{ij} \quad (3)$$

where w_j ($0<w_j<1$) denotes the weight of j^{th} criterion,

and $\sum j^m = 1$, $w_j=1$.

Table13: Weighted Normalised evaluation matrix (rij).

	R	D	AB	YS	C	TC
316L SS	0.0262	0.0452	0.0684	0.2101	0.1852	0.0824
WC-Cr3C2-Ni	0.0167	0.0452	0.1535	0.1782	0.1852	0.0498
WC-10 Co-4Cr	0.0362	0.0996	0.0473	0.0584	0.2686	0.3267
Stellite 6	0.0262	0.0554	0.1453	0.2101	0.0735	0.0498
70Ni30 Cr	0.0262	0.0452	0.0684	0.0831	0.1852	0.0676
Al2O3-TiO2	0.0103	0.0331	0.1535	0.2101	0.1186	0.0498

Determine the negative ideal solution points (Step6)

Negative-
ideal solution (point) can be calculated as given in equation (4)

$$ns=[ns_j]_{1xm};\ ns_j=\min_i r_{ij} \quad (4)$$

The obtained values are shown below

Table14: Negative ideal Solution Points (ns).

Criteria	H3/E2 ratio (R)	Density(D)	Adhesive Bonding (AB)	Yield Strength(YS)	Cost (C)	Thermal Conductivity(TC)
Negative-Ideal	0.0103	0.0331	0.0473	0.0584	0.0735	0.0498

Calculation of Euclidean and Taxicab distances of alternatives (Step 7)

Compute the Euclidean and Taxicab distances of alternatives from the negative-ideal solution as given in equations (5) and (6) respectively

$$E_i=\sqrt{\sum_{j=1}^{m}(r_{ij}-ns_j)^2} \quad (5)$$

$$T_i=\sum_{j=1}^{m}|r_{ij}-ns_j| \quad (6)$$

Table15: Euclidean (Ei) and Taxicab (Ti) distances.

Alternatives	Ei	Ti
316L SS	0.4984	0.3134
WC-Cr3C2-Ni	0.4993	0.3435
WC-10Co-4Cr	0.687	0.5126
Stellite 6	0.1827	0.2562
70Ni30Cr	0.4746	0.1716
Al2O3-TiO2	0.3529	0.3031

Result

The ranking of alternatives can be done by formulating the relative assessment score of each alternative. To achieve this the following steps has to be performed.

Construct the relative assessment matrix

A relative assessment matrix [Ra] to be tabulated according to the equation (7)

A relative assessment matrix [R_a] to be tabulated according to the equation (7)

$$R_a = [h_{ik}]_{nxn} \quad (7)$$

$$h_{ik} = (E_i E_k) + (\psi(E_i - E_k) x (T_i - T_k))$$

Where $k \in \{1, 2, ..., n\}$ and denotes a threshold function to recognize the equality of the Euclidean.

$\Psi(x) = 1 \quad \text{if } |x| \geq \tau$

$\Psi(x) = 0 \quad \text{if } |x| < \tau$

In this function, τ is the threshold parameter that can be set by the decision maker. It is suggested to set this parameter at a value between 0.01 and 0.05. If the difference between Euclidean distances of two alternatives is less than τ, these two alternatives are also compared by the Taxicab distance. In this study, it is assumed that τ = 0.02 for the calculations.

Table16: Relative Assessment Matrix (Ra).

316L SS	0	-9E-04	-0.188	0.3161	0.0239	0.1455
WC-Cr3C2-Ni	0.0009	0	-0.187	0.3172	0.0248	0.1465
WC-10 Co-4Cr	0.1894	0.1883	0	0.5069	0.2139	0.3355
Stellite 6	-0.315	-0.316	-0.502	0	-0.292	-0.17
70Ni30 Cr	-0.024	-0.025	-0.211	0.2914	0	0.1213
Al2O3-TiO2	-0.145	-0.146	-0.333	0.1704	-0.122	0

Calculate the assessment score

Once the relative assessment matrix got constructed, the assessment score matrix of each alternative can be developed according to the equation (8)

$$H_i = \sum_{k=1}^{n} h_{ik} \quad (8)$$

Table17: Assessment Score Matrix (Hi).

Alternatives	Hi
316L SS	0.2966
WC-Cr3C2-Ni	0.3023
WC-10Co-4Cr	1.4339
Stellite 6	-1.596
70Ni30Cr	0.1534
Al2O3-TiO2	-0.576

Ranking of Alternatives

Rank the alternatives according to the decreasing values of assessment score (H). The alternative with the highest H is the best choice among the alternatives

Table18: Ranking

	Hi	Rank
316L SS	0.2966	3
WC-Cr3C2-Ni	0.3023	2
WC-10Co-4Cr	1.4339	1
Stellite 6	-1.596	6
70Ni30Cr	0.1534	4
Al2O3-TiO2	-0.576	5

From the table, it can be seen that WC-10Co-4Cr has been ranked as the best coating material for the AISI 304L SS substrate.

Discussions

The purpose of this study is to use the CODAS approach to pick the best LISCO supplier in Libya. MCDM strategies are well known for their popularity in tackling supplier assessment and selection difficulties. Furthermore, it incorporates both quantitative and qualitative criteria, some of which may entail uncertainty, and they may be contradictory at times. Some elements of the CODAS technique have not been examined by the other MCDM methods. In this research, the CODAS approach is used to rank suppliers in the LISCO using a real-world case study. The findings revealed that the CODAS method might improve quality decisions by making the process more rational, explicit, and efficient.

Conclusion and Future Work

The decision-making process was precise and efficient. Wc- Co- Cr is the coating material that demonstrates greater erosion corrosion resistance than the other options when using this integration process.

Low porosity, high hardness, and an optimal structure are all characteristics of the coating. Compared to the bare AISI 304 L SS substrate, the Wc- Co- Cr coating provides good mechanical support. Wc- Co- Cr coating material is both environmentally benign and cost effective.

Oher The scope of this research is to employ multi-criteria methods to determine the optimal coating material. The proposed decision-making approach is extremely adaptable and can readily handle both quantitative and qualitative factors. [7]

The same work can also be carried out by means of other MCDM techniques. Optimization methods also can be used for selection of suitable material by using either Genetic Algorithm or Neural Network methods.

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