International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 11 Issue: 09 | Sep 2024 www.irjet.net p-ISSN: 2395-0072

ANALAZTION OF BOILER PERFORMANCE WITH RESPECTIVE CHEMICAL SCALE FORMATION BY USING AI TECHNOLOGY

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ABSTRACT:

Boiler water treatment uses chemicals to condition and treat boiler feed water. Some common chemicals used in boiler water treatment include:

Oxygen scavengers: Remove dissolved oxygen from boiler water to prevent corrosion.

Alkalinity builders: Raise the pH of boiler water to protect the boiler from corrosion and scale buildup.

Scale inhibitors: Prevent scale from forming on the inside of the boiler by coating the metal surfaces.

Corrosion inhibitors: Protect the boiler from corrosion.

Phosphates-dispersants: Neutralize the hardness of water by forming tri calcium phosphate.

Natural and synthetic dispersants: Increase the dispersive properties of the conditioning products.

Sequestering agents: Act as inhibitors and implement a threshold effect

Keywords: ACCDM,WSB,ML,RTM.

1.INTROTUCTION:

Scale formation using AI technology involves:

1.1 Data Collection: Gathering data on boiler operating conditions, water quality, and performance metrics.

1.2 Machine Learning (ML) Model Development: Machine learning in boilers refers to the application of advanced data analysis and modeling techniques to predict, detect, and optimize boiler operations.

1.3 Pattern Recognition: Pattern recognition in boilers involves using algorithms to identify and interpret meaningful patterns in data generated by various sensors and monitoring systems.

1.4 Predictive Analytics: Predicting when a boiler component is likely to Fail, allowing for proactive maintenance.

1.5 Real-time Monitoring: Real-time monitoring on boilers involves continuously tracking and analyzing data from various sensors and systems to ensure safe, efficient, and reliable operation.

1.6 Optimization: achieve maximum efficiency, reliability, and safety while minimizing energy consumption, emissions, and maintenance costs.

2. AI technologies used:

2.1 Neural Networks: A neural network on a boiler is a machine learning model that uses artificial neural networks to predict, monitor, and optimize boiler performance.

2.2 Decision Trees: Decision Trees on a boiler are a machine learning model that uses a tree-like structure to predict, classify, or optimize boiler performance.

2.3 Clustering: Clustering on a boiler is a machine learning technique that groups similar data points or operating conditions into clusters

Regression Analysis: For predicting scale formation and boiler performance.

2.4 Benefits:

1.Improved Boiler Efficiency

2.Reduced Maintenance Costs

3. Extended Equipment Life

4. Enhanced Safety

By leveraging AI technology, boiler operators can proactively address chemical scale formation, ensuring optimal performance and minimizing downtime.

3.Chemical test for boiler water:

WATER TEST	MAINTAIN READINGS	LESS THAN PPM	GREATER THEN PPM
Alkalinity test	150-300 ppm	_	_
Chloride test	0-300 ppm	_	300 ppm Blow down
Phosphate test	20-40	_	40 Blow down
PH value test	10.5-11.5	_	_
Condensate PH test	8.3-8.6	8.3	8.6
Hydrazine test	0.1-0.2	0.1	0.2
Conductivity test	9-11		

4. Different types of sensors used on boiler:

Figure-1 types of sensor

These are the various sensors used on boiler.

4.1PH Detector:

A pH detector on a ship's boiler measures the acidity or alkalinity of the water, ensuring it remains within a safe range to prevent corrosion.

4.2Alkalinity detector:

The alkalinity detector measures the concentration of alkaline substances (such as hydroxide, carbonate, and bicarbonate ions) in the boiler water. This ensures the water remains within a safe ph.

4.3 Phosphate Detector:

A phosphate detector on a ship's boiler measures the concentration of phosphate ions in the boiler water.

4.4Chlorate Detector:

A chlorate detector on a ship's boiler measures the concentration of chlorate ions in the boiler water.

4.5Conductivity test Detector:

A conductivity test detector on a ship measures the ability of the boiler water to conduct electricity, indicating the presence of dissolved solids and contaminants.

Figure-2: Chemical Level

5. AUTOMATED CHEMICAL CONTEND DETECTING MACHINE:

Figure: Automated chemical content

Chemical Content Detecting Machine (CCDM) is an automated system that continuously monitors and controls the chemical content in a boiler's water, ensuring optimal levels for efficient and safe operation.

5.1Usage:

- **Water sampling:** CCDM takes a continuous water sample from the boiler.
- **Chemical analysis:** The system analyzes the sample for various chemical parameters like pH, conductivity, alkalinity, and oxygen levels.
- **Comparison with set points:** CCDM compares the analyzed values with pre-set limits.

- **Alarm and correction:** If values exceed limits, CCDM triggers an alarm and automatically adjusts chemical dosing to restore optimal levels.
- **Data logging and reporting:** CCDM records and reports data for maintenance, troubleshooting, and compliance.

5.2Benefit:

- **Real-time monitoring:** Continuous monitoring ensures prompt response to changes.
- **Accurate control:** Automated dosing ensures precise chemical levels.
- **Reduced manual errors:** Minimizes human error in sampling and analysis.
- **Improved efficiency:** Optimized chemical levels enhance boiler performance.
- **Compliance:** Meets regulatory requirements and industry standards.

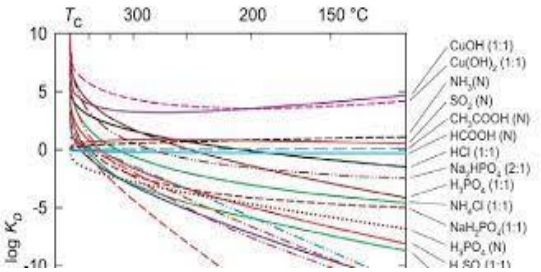

Figure-4: Graph

5.3 Commonly detected chemicals:

- PH
- Conductivity
- Alkalinity
- Oxygen levels
- Hydrazine
- Phosphate
- Chloride
- Sulfite

CCDM ensures reliable and efficient boiler operation, reducing downtime, and maintenance costs.

6. Water softening in boiler:

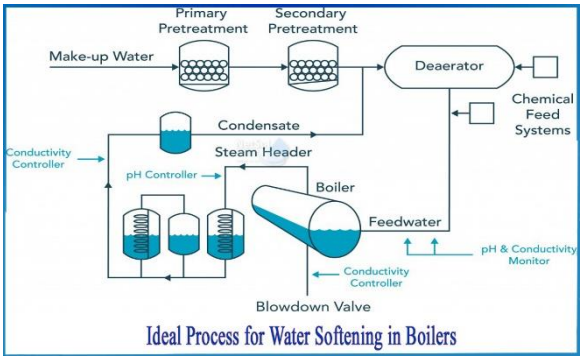

Figure-5 Ideal process for water softening in boilers

- **Pre-treatment**: Remove suspended solids, sediment, and other impurities from the feed water using physical methods like filtration or sedimentation.
- **Softening**: Use ion exchange resins to remove calcium and magnesium ions, replacing them with sodium or potassium ions.
- **Re-mineralization:** Add back beneficial minerals to the water to maintain a stable pH and prevent corrosion.
- **PH adjustment:** Adjust the pH to the optimal range (usually 8.5-9.5) to prevent corrosion and scaling.
- **Monitoring**: Continuously monitor water quality, including hardness, pH, and conductivity.
- **Regeneration:** Periodically regenerate the ion exchange resins to maintain their effectiveness.
- **Blow down:** Regularly blow down the boiler to remove accumulated impurities and maintain water quality.
- **Chemical treatment:** Add chemicals as needed to prevent scaling, corrosion, and foaming.
- **Water testing:** Regularly test the water to ensure it meets the required standards.
- **Maintenance:** Regularly maintain and inspect the water softening equipment to ensure optimal performance.
- By following this process, you can ensure effective water softening, preventing scaling and corrosion, and maintaining efficient boiler operation.

7. Conclusion:

- In conclusion, the use of AI technology in analyzing boiler performance and preventing chemical scale formation offers numerous benefits, including:
- Predictive maintenance and real-time monitoring.
- Optimized chemical treatment and automated control.
- Improved efficiency and reduced maintenance.
- Extended equipment life and cost savings.
- Data-driven insights for informed decision-making.

By harnessing the power of AI, boiler operators can ensure optimal performance, minimize downtime, and reduce maintenance costs. The integration of AI technology in boiler water treatment is a significant step forward in maintaining efficient and reliable boiler operations.

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