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ANALYSIS OF DISCREPANCY CONDUCTIVITY DATA MEASUREMENT AMONG ONLINE ANALYZER AND LABORATORY

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ABSTRACT

XYZ.Co.Ltd is an Oil and Gas Company that needs steam produced by the Boiler to support of production system operation, The Conductivity of Boiler Feed Water (BFW) which is generated by a Mix Bed Filter (MBF) has been controlled by an Online Analyzer and Laboratory. Beginning from 01 April 2017 has been data discrepancy between Online Data Results against Laboratory Results. Gap Analysis has been done to determine of desired situation / Goal, and the Goal of the Research is to mitigate of difference in conductivity value which resulted from the Online Analyzer against the Laboratory. Then, Root Cause Analysis uses the Ishikawa Diagram to observe the root cause of the problem with several action plans to do. Ishikawa Diagram analysis uses Root Cause Analysis resulting 1 (one) Conformity found in the Machine Factor is the level Calibration of Conductivity Meter in Online Analyzer, because after did Chi-Square test to hypothesize of data which is generated of X2calc > X2crit as rejected and this Root Cause Analysis result has reported to Online Analyzer Section to do some Corrective Action then after Corrective action there is no discrepancy data's anymore.
***Keywords**: Conductivity; Online Analyzer; Laboratory; Ishikawa*

ABSTRAK

XYZ.Co.Ltd sebagai salah satu Perusahaan Migas yang membutuhkan steam yang dihasilkan oleh Boiler untuk menunjang operasional sistem produksi, Konduktivitas Boiler Feed Water (BFW) yang dihasilkan oleh Mix Bed Filter (MBF) telah dikontrol oleh Online Analyzer dan Laboratorium. Mulai tanggal 01 April 2017 telah terjadi ketidaksesuaian data antara Hasil Data Online dengan Hasil Laboratorium. Gap Analysis dilakukan untuk menentukan Situasi/Tujuan yang Diinginkan, dan Tujuan Penelitian adalah memitigasi perbedaan nilai konduktivitas yang dihasilkan oleh Online Analyzer terhadap Laboratorium. Kemudian dilakukan Root Cause Analysis menggunakan Diagram Ishikawa untuk mengetahui akar permasalahan dan beberapa rencana tindakan yang harus dilakukan. Diagram Ishikawa atau Root Cause Analysis yang digunakan menghasilkan 1 (satu) Non-Conformity yang ditemukan pada Faktor Mesin yaitu Kalibrasi Tiga Tingkat Conductivity Meter pada Online Analyzer, karena setelah dilakukan uji Chi-Square untuk menghipotesiskan data yang menghasilkan X2calc > X2crit ditolak dan hasil RoottCause Analysis dilaporkan untuk dilakukan tindakan perbaikan pada online analyzer dan setelah dilakukan perbaikan maka perbedaan hasil pengukuran tidak terjadi lagi.
***Kata Kunci**: Konduktivitas; Online Analyzer; Laboratorium; Ishikawa*

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INTRODUCTION

XYZ.Co.Ltd a Midstream Company or Refinery Company located in Qatar that produces LPG and Diesel and Naptha, and those products will be sold to local and overseas customers. Nicholas and Paul (2009) mention that the first step in the refining process is the separation of crude oil into various fractions or straight-run cuts by distillation in an atmospheric distillation column. The heat energy in fractionation towers comes from hot steam where used to assist in the separation of chemical products that contain components with different boiling points.

Steam is normally generated in a boiler by transferring heat from hot combustion gases or other hot process streams to water (Mamoru Ozawa, 2021). On the Boiler Unit, specific quality water called Boiled Feed Water (BFW) is introduced to hot pipe tubes on Boiler Unit, where the heat energy of pipes has resulted from fuel burned in the boiler. Cation Conductivity is one specification properties should be a concern on Boiler Feed Water (BFW) thus to adhere to this matter XYZ.Co.Ltd has been operating of Mix Bed Filter or Ion Exchange Facility (GE Power& Water, 2017) to produce water use for Boiler Feed Water.

Regarding Mullin (2017) Laboratory quality control is designed to detect, reduce, and correct deficiencies in a laboratory's internal analytical process also as quality assurance (Hibbert, Brynn., 2017) to improve the quality of the results reported by the laboratory, In monitoring a process using Statistical Quality Control (SQC) samples of the process output would be taken and sample statistics calculated (Jacob and Chase, 2018). For several important process points, monitoring of the process has been conducted by an analyzer which is auto-connected with statistical process control as a powerful collection of problem-solving tools (Montgomery, 2009) and also by analysis in the laboratory, are purpose: Compare data which was a resulted by the Analyzer which is present on Statistical Process Control versus Laboratory Data. Data from the laboratory is used as backup data if the online analyzer has a problem.

Starting from 1 April 2017, there has been a discrepancy measurement of conductivity (Figure 1.) from mixed bed Filter samples among Laboratory Results and Online Analyzer results.

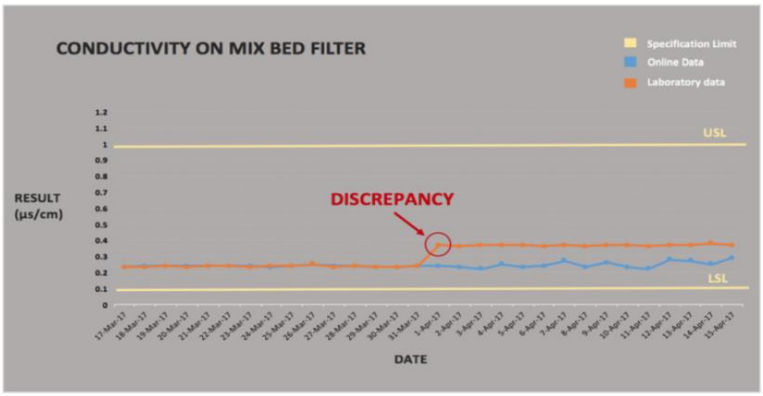

Figure 1. Discrepancy conductivity measurement

Gap Analysis is the comparison of actual performance with potential or desired performance (Keith Emery, 2017), where online analyzer differences with the result from data's laboratory and desired situation is data from analyzer not difference which resulted by online analyzer.

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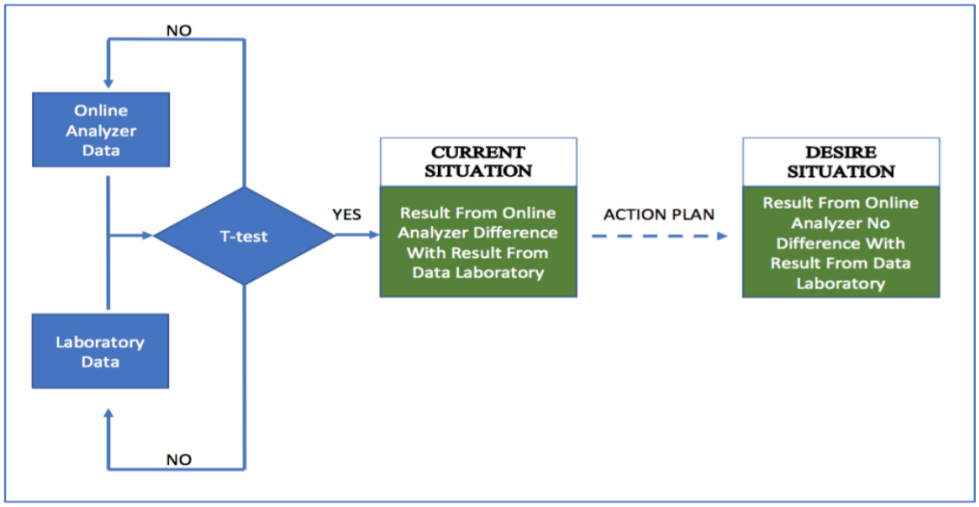
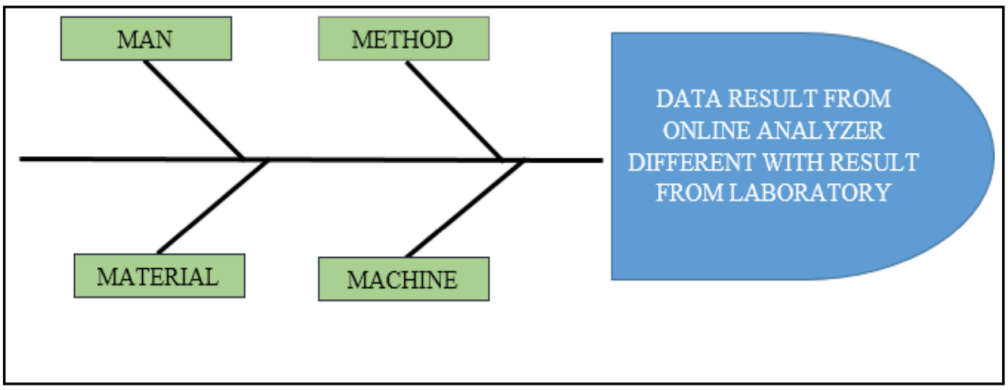
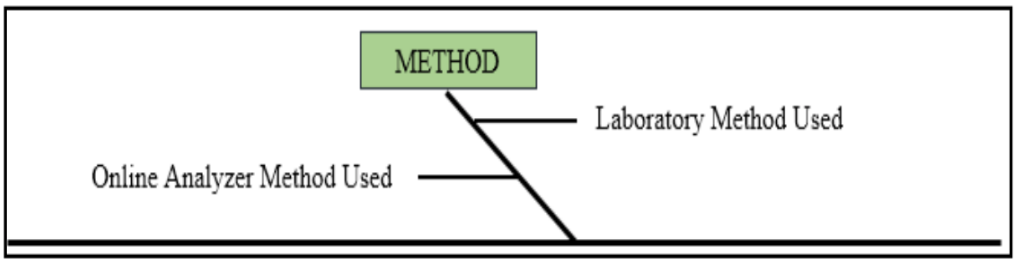


Figure 2. Gap analysis

The Ishikawa Diagram is to help teams categorize the many potential causes of problems or issues in an orderly way. The method consists of systematically identifying (krisnamoorthi et al., 2018) all the sources that might contribute to the undesirable symptom(s) under investigation. To follow a uniform format, it is suggested (Ishikawa, 1985) that the causes be investigated and recorded under the major categories shown in the diagram in Figure 3.





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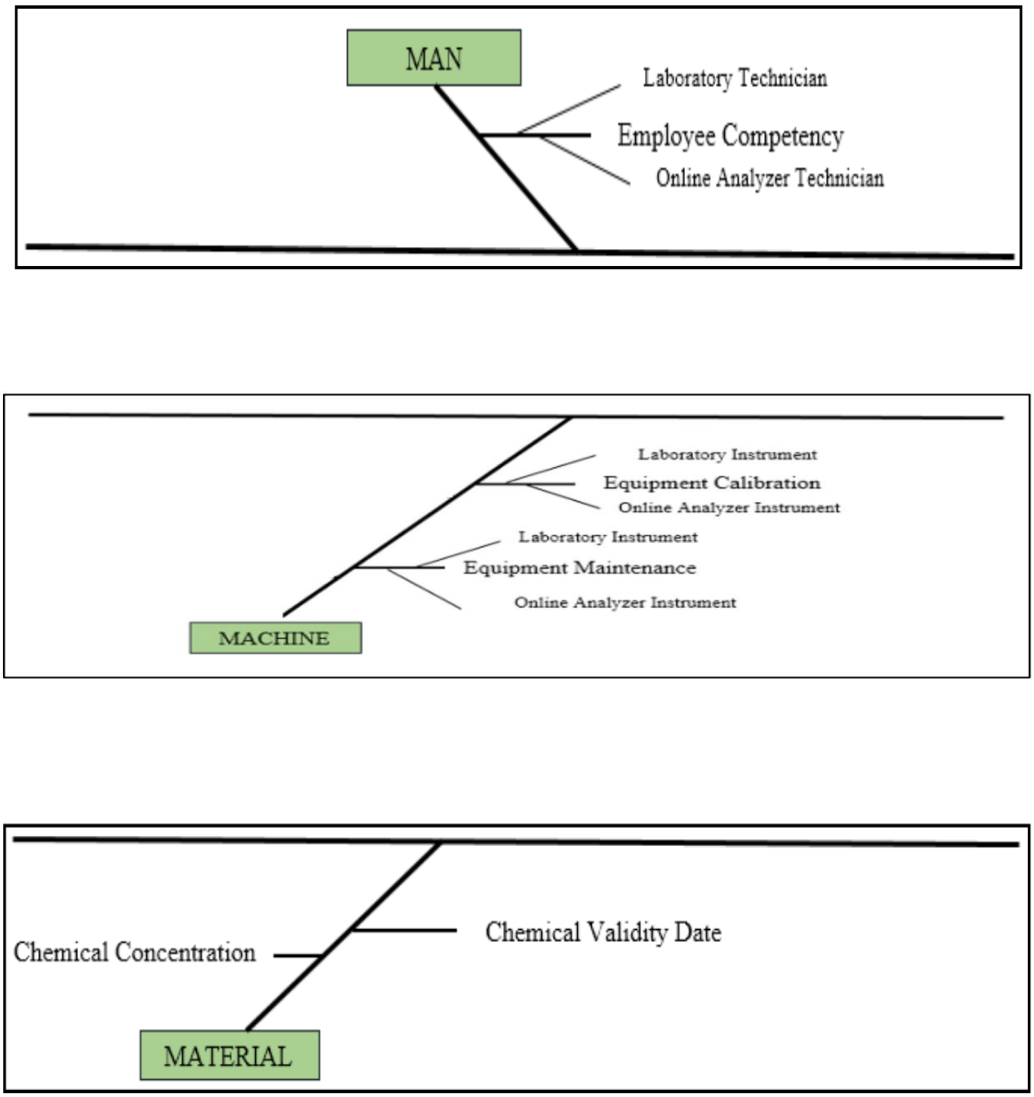

Figure 3. Ishikawa diagram

RESEARCH METHODOLOGY

Statistical technic is tools process that many types of data's (Ronald et.al , 2007), and hypothesis testing procedures are quite useful in many types of statistical quality control problems (Montgomery, 2018) some hypothesis technic are one-pair t-tests, F-test, and X^2 test and uncertainty. All of actions on methods research are set as flowcharts (Kothari, Gaurav, 2014) as activities guidelines shown on Figures 4 and 5.

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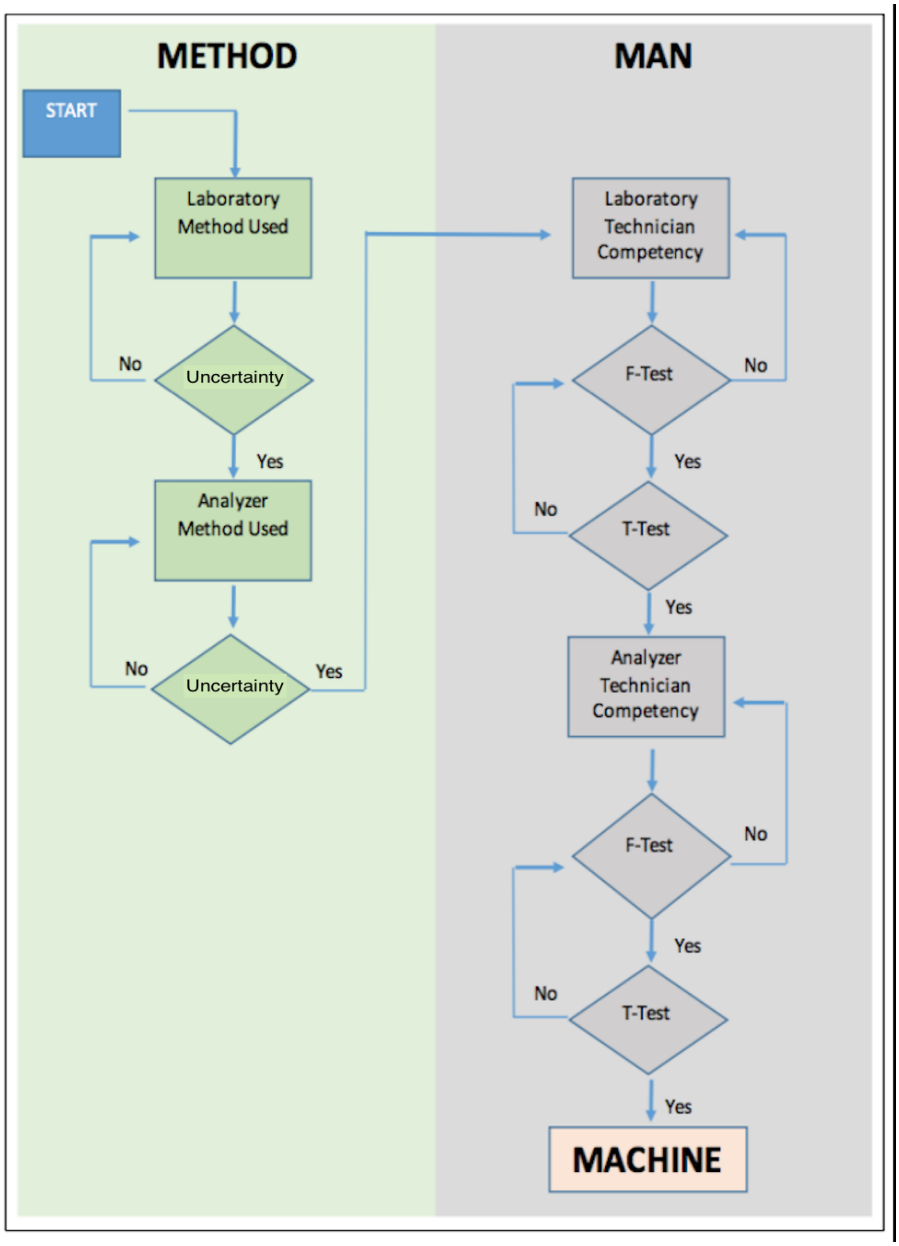

Figure 4. Method and man analysis flowchart

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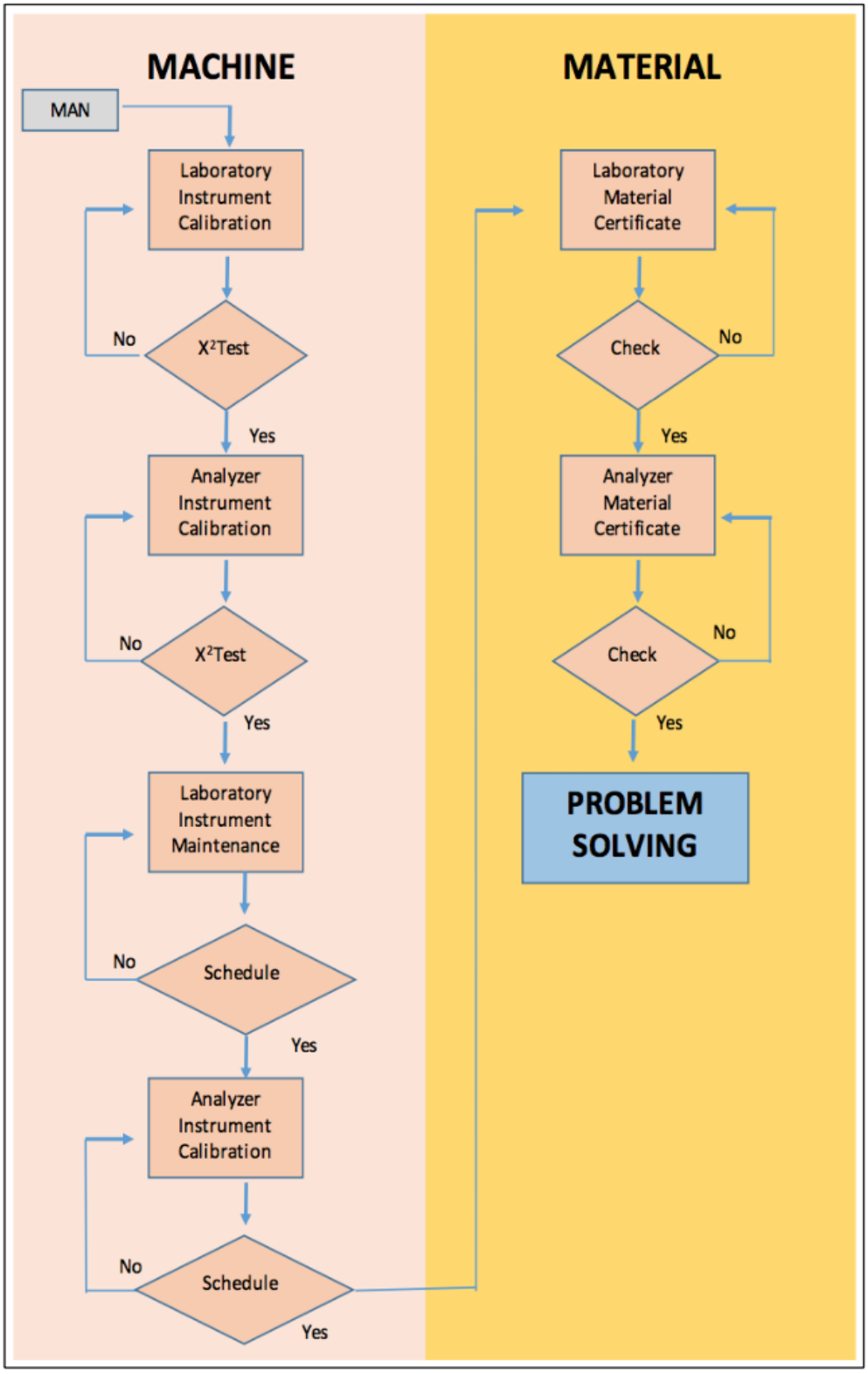

Figure 5. Machine and material analysis flowchart

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RESULT AND DISCUSSION

Method Factor

Table 1. Laboratory used validation records

No	Date	Result (µs/cm)
1	13-Apr-05	1410
2	14-Apr-05	1411
3	15-Apr-05	1419
4	16-Apr-05	1412
5	17-Apr-05	1409
6	18-Apr-05	1412
7	19-Apr-05	1411
8	20-Apr-05	1410
9	21-Apr-05	1410

Uncertainty of Standar Solution is 1408 ± 0.5 % or 1408 ± 70.4 (1337.6 – 1487.4) then Uncertainty of Laboratory used validation is 1410.4 ± 1.0749 (1409.3 – 1411.5) so all data's are accepted.

Table 2. Online analyzer used validation records

No	Date	Result (µs/cm)
1	25-Apr-05	26.62
2	26-Apr-05	26.61
3	27-Apr-05	26.60
4	28-Apr-05	26.61
5	29-Apr-05	26.63
6	30-Apr-05	26.61
7	01-May-05	26.62
8	02-May-05	26.62
9	03-May-05	26.60
10	04-May-05	26.61

Uncertainty of Standard Solution is 26.6 ± 2.5 % or 26.6 ± 0.665 (25.935 – 27.265) then the Uncertainty of Online Analyzer used validation is 26.292 ± 0.0368 (26.555 – 26.69) so all data's are accepted.

Man Factor

Table 3. Laboratory training record

No	Date	Result (µs/cm)	
		Trainer	Trainee
1	02-Jun-05	500	499
2	02-Jun-05	500	501
3	02-Jun-05	501	502
4	02-Jun-05	496	499
5	02-Jun-05	500	501
6	03-Jun-05	501	500
7	03-Jun-05	497	499
8	03-Jun-05	502	500
9	03-Jun-05	500	499
10	03-Jun-05	499	498

F test statistical result is $F_{criteria\ 9,9,0.05} = 3.177$ and $F_{calc\ 9,9,0.05} = 1.2338$, thus $F_{calc9,9,0.05} < F_{criteria\ 9,9,0.05}$, H_0 accepted means there is no difference variance of those data's.
T test statistical result is $T_{criteria\ 9,0.05} = 1.883$ and $T_{calc\ 9,0.05} = 0.414$, thus $T_{calc\ 9,0.05} < T_{criteria\ 9,0.05}$, H_0 accepted means there is no difference mean of those data's.

Table 4. Online analyzer training record

No	Date	Result (µs/cm)	
		Trainer	Trainee
1	13-Jun-05	499	502
2	13-Jun-05	501	500
3	13-Jun-05	500	499
4	13-Jun-05	499	497
5	13-Jun-05	500	501
6	14-Jun-05	498	500
7	14-Jun-05	500	500
8	14-Jun-05	497	498
9	14-Jun-05	501	501
10	14-Jun-05	503	499

F test statistical result is $F_{criteria\ 9,9,0.05} = 3.177$ and $F_{calc\ 9,9,0.05} = 0.785$, thus $F_{calc\ 9,9,0.05} < F_{criteria}$, H_0 accepted means there is no difference variance of those data's.
T test statistical result is $T_{criteria\ 9,0.05} = 1.883$ and $T_{calc\ 9,0.05} = 0.084$, thus $T_{calc\ 9,0.05} < T_{criteria\ 9,0.05}$, H_0 accepted means there is no difference mean of those data's.

Machine Factor

Table 5. Laboratory calibration record

Date	Level	STD (µs/cm)	Result (µs/cm)
19-Jun-17	1	10	9.88
	2	26.6	26.4
	3	500	499

Undertaken Chi-Square hypothesis resulted $X^2_{Criteria\ 2,0.05} = 5.991$ and $X^2_{Calc\ 2,0.05} = 0.001$,because
$X^2_{Calc\ 2,0.05} < X^2_{Criteria\ 2,0.05}$ then H_0 accepted..

Table 6. Online analyzer calibration record

Date	Level	STD (µs/cm)	Result (µs/cm)
20-Jun-17	1	10	5.82
	2	26.6	18.5
	3	500	483

Undertaken Chi-Square hypothesis resulted $X^2_{Criteria\ 2,0.05} = 5.991$ and $X^2_{Calc\ 2,0.05} = 6.02$ because $X^2_{Calc} > X^2_{Criteria}$ then $H_0 = Pi$, Result not accepted.

Material Factor

Table 7. Laboratory material record

Concentration (µs/cm)	Uncertainty
10	±3%
26.6	±2.5%
500	±1%
1408	±0.5%

With the Solution Certificate addressed concentration, and there is no difference, meaning that the material/solution used in the Laboratory to do Calibration and Validation to support Conductivity Measurement is valid.

Table 8. Online analyzer material record

Concentration (µs/cm)	Uncertainty
10	±3%
26.6	±2.5%
500	±1%
1408	±0.5%

The Solution Certificate addressed concentration, and there is no difference, meaning that the material/solution used in the Laboratory to do calibration and validation to support of Conductivity Measurement is valid.

Root Cause Analysis by Ishikawa diagram analysis and Statistical approach techniques resulted 1 (one) Non-Conformity found in Machine Factor is Three Level Calibration of Conductivity Meter in Online Analyzer because Chi-Square test to hypothesize of data which generating of $X^2_{calc} > X^2_{crit}$ as rejected and this Root Cause Analysis result has reported to Online Analyzer Section to do some Corrective Action furthermore Online Analyzer Section has done several actions to solving are;

1. Invited vendor to repair to Online Conductivity Meter.
2. During on repair of the Online Conductivity Meter, Data from the Laboratory as reference support of Statistical Process Control for Conductivity in Mix Bed Filter.
3. When the Online Conductivity Meter is back to service, do calibrate for three-level calibration.

After it has corrected action to the Online analyzer, observation to measurement results indicate there is no discrepancy in data measurement between the Online analysis result and Laboratory result as shown in Figure 6.

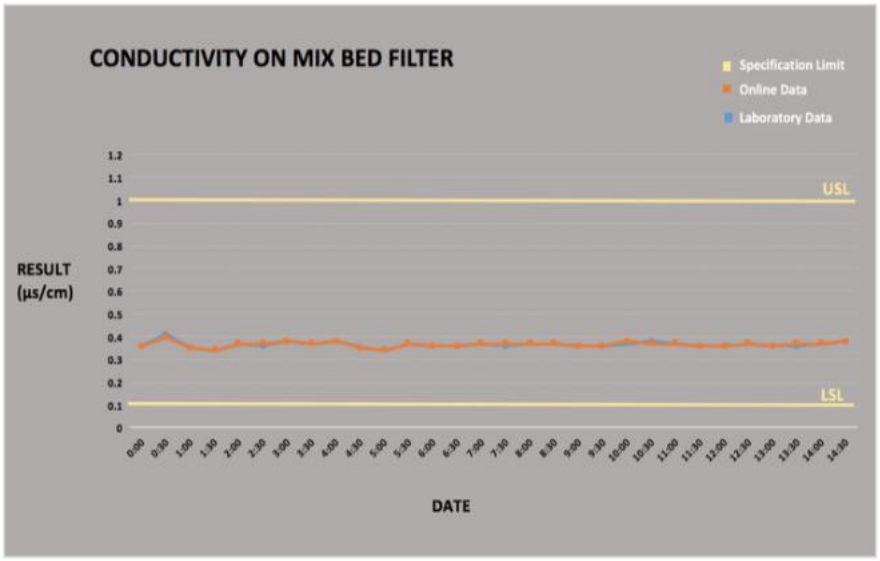

Figure 6. Conductivity measurement after problem solving

CONCLUSIONS

Root Cause Analysis by Ishikawa diagram analysis and Statistical approach techniques resulted from 1 (one) Non-Conformity found in Machine Factor which is followed up by corrective action to repair of Online analyzer resulted in no Significant Difference of Conductivity Measurement between the Online Analyzer and Laboratory, it means that research has been reach to goal/desire situation which declared in background problem.

After the Online Analyzer Conductivity has been rectified back to service, a Calibration schedule with 3 different standards should be prepared so that there will not be some discrepancy of data between the Online Analyzer and the laboratory in the future.

REFERENCES

Douglas C Montgomery (2009).Introduction Quality Control .6th edition, Arizona State University.

D S J Jones., 2015, Atmospheric and Vacuum Crude Distillation Units in Petroleum Refineries, 2nd Handbook Sof Petroleum Processing , Springer International Publishing Switzerland.

F.Robert Jacob,Richard B Chase., 2018, Operations and supply chain management, Indiana University and University of Southern California.

GE Power& Water, 2017, Ion Exchange,https://www.gewater.com/handbook.

Hibbert, D. Brynn.,2017, Quality Assurance in the Analytical Chemistry Laboratory. Cary, US: Oxford University Press, 2007. ProQuest ebrary.

Kothari C R, Garg Gaurav, 2014, Research Methodology, 3 Edition, Mumbai

K S Krishnamoorthi,V Ram Krishnamoorthi, Arunkumar Pennathur.,2018, A First Course in Quality Engineering, Integrating Statistical and Management Methods of Quality-CRC Press.

Mamoru Ozawa,2021, Introduction to Boiler, Volume 2 in JSME Series in Thermal and Nuclear Power Generation.

Mullins, 2017, Eamonn. Statistics for the Quality Control Chemistry Laboratory. Cambridge, GB: Royal Society of Chemistry, 2003. ProQuest ebrary.

Nicholas P. Cheremisinoff, Paul Rosenfeld., 2009, Handbook of Pollution Prevention and Cleaner Production - Best Practices in The Petroleum Industry.

Ronald, E.W., Raymond, H.M., Sharon, L.M. and Keying, Y. (2007) Probability and Statistics for Engineers and Scientists. Eighth Edition, Pearson Prentice Hall, Pearson Education Inc., Upper Saddle River, 194-197.