IAQ QUALITY SUSTAINABILITY AWARD 2020

APPLICATION FORM

The complete application includes this application form, a summary (One-page summary) for publication (Attachment 1) and an optional technical improvement report (Attachment 2). Refer to "Applying for the IAQ Quality Sustainability Award (QSA)" for more details. The maximum length of this application form is 4 pages.

For 2021, for applicants in China and India, please send application to your national Quality Sustainability Award partner as per their instructions. (see "List of Partners" for your local contact). For applicants from all other countries than China and India, please submit your complete application to iaqaward@sandholm.se

The official name of the organisation Ashok Leyland Ltd. (India)		
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Names and roles of all team-members and organisational belonging *Team members: Saravanan P M, Sukanta Patra, Sachin Kumar Dhiman, Prakash U. Project Sponsor: G Gopa Kumar*		
Project Completion Date February 2019		
Project connection to UN Sustainability Development Goal(s). Please delete goals **not** applicable for your application. A project applying for the IAQ Sustainability Award can focus on one or several of the UN Sustainability Development Goals. For more information about the goals see; https://sustainabledevelopment.un.org/). GOAL 12: Responsible Consumption and Production		
The name of the quality sustainability project (max. 100 characters) Phosphate Sludge (hazardous waste) generation reduction in Cab pre-treatment line		

PROJECT DESCRIPTION; *General description of the improvement and development work carried out in the project. Explain the essence of the project, the problem statement, the analysis performed, steps taken, and methodology used. When was it started and when was it completed? Describe also the resources that have been used, human or financial. Finally, describe how the project has contributed to sustainable development in the sense of economic- environmental- and / or social sustainability and what results achieved. Formulations here can preferably build on material from your One-page summary, Appendix 1. Max. 3000 characters)*

A massive amount of waste generated today end up in landfills which apart from contributing to soil & ground water contamination and Greenhouse gas (GHG) emissions also leads to serious concerns of public health and large scale environmental degradation. Our operations include processes such as pressing, fabrication, painting, assembling and testing of vehicles at our manufacturing sites. As a result of our process related activities, we generate solid and liquid waste of both hazardous and non-hazardous waste categories. We comply with the waste management rules prevalent in the country to ensure compliance with respect to transportation and disposal of waste. All our manufacturing sites have established a waste management site level in charge of sorting, classifying and handing over the waste to disposal companies authorized by the state pollution control boards.
In order to continuously reduce the volume of waste, we aim to recycle materials wherever possible. Contributions are made by initiatives at individual site level, such as with the "Zero waste to landfill" campaign.
One of the projects that addressed Phosphate Sludge (hazardous waste) is explained here.
As per state pollution control board (TNPCB) regulation, the authorized limit for paint sludge generation is 300 MT/annum & phosphate sludge generation is 24MT/annum. Paint sludge generation is well within the authorized limit whereas, Phosphate sludge generation (Hazardous Waste) is a concern as it is nearing the authorized limit. Going forward, there's a risk involved as the production volumes are predicted to be higher by 20% which may further lead to a possible notice from TNPCB and Loss of Organization's Image.

Project Metric: Mean Phosphate sludge generation
Unit of Measurement (UOM): Gram/Sq.m
Baseline: 6.92 Target: 4

Historic data suggests that Average Phosphate sludge generation is 6.92 g/sq.m and the sludge generation trend is stable.

Note. More information about the award and how to apply can be found on the IAQ Quality Award homepage

We performed Measurement system analysis (MSA) for titration checking method (Phosphate sludge measurement process) to verify whether the measurement system is capable i.e. project metric data is accurate & precise. MSA results suggests that the measurement system is capable as Gage R&R is 0.66% and No. of distinct categories (NDC) is 214.

Nine probable causes are identified for high phosphate sludge generation. Detailed cause validation reveals that moisture content present in Phosphate sludge is very high (61% of sludge weight). To address this issue, Phosphate sludge drying bed is installed with an expenditure of INR 0.1 Million and drying process is continued to remove moisture.

As a result, Mean Phosphate sludge generation reduced from 6.93 g/sq.m to 5.22 g/sq.m. But even with improved performance, annual sludge disposal will stand at 26 MT against Govt. regulation of 24 MT. We would like to reduce it further considering 20% spike in production volumes (forecast) in FY20.

To further reduce the Sludge, team searched out for new generation Pre-treatment Chemicals. Through our research, we came to know about 2 such chemicals.

1. Sludge free Oxsilane coating (Nano technology) which is widely used in European countries. However, no auto OEM in India is using it currently.
2. Advent of compact & fine phosphate coating which is widely used in Japanese auto OEMs. However, it is still in primitive stages of economical & technical establishment in India.

However, feasibility study is to be done for adopting these chemicals. We have evaluated both chemicals through a 16 point criteria. It is understood that the best and most suitable is compact & fine phosphate coating chemical.
As a result, Mean Phosphate sludge generation is reduced to 4 g/sq.m. With this, Estimated Annual sludge generation will be at 20 MT against the Govt. regulation of 24 MT for production volume of 1 Lakh cabins.

As part of risk analysis, we checked if there's any adverse impact on Consequential metric (Phosphate coating weight). Phosphate coating weight process is stable and capable as Ppk is 1.83.

RESULTS AND EFFECTS ACHIVED – LEVERAGE POTENTIAL – EFFECTS SUPPORTING SUSTAINABLE DEVELOPMENT

RESULTS AND EFFECTS ACHIEVED; *Describe and detail the results that have been achieved. What has been accomplished? Please describe your results, when applicable in numerical measurements/numbers. Refer to relevant UN Sustainability Goals and present measurable results and effects. (Max. 1000 characters)*

UN SDG Goal 12: Responsible Consumption and Production.
Indicator 12.4.2: Hazardous waste generated per capita and proportion of hazardous waste treated, by type of treatment

Following are the effects and results achieved from the project:

1. Phosphate sludge generation reduced by 42% (from 6.93 g/sq.m to 4 g/sq.m).
2. Estimated Annual sludge disposal will be at 20 MT against government's regulation of 24 MT for production volume of 0.1 Million cabins.
3. Phosphate coating weight process is stable and capable as Ppk is 1.83.
4. Smooth, Uniform and Fine Phosphate coating.
5. Phosphating process time reduced from 90 sec to 60 sec. Productivity improved by 12%.
6. ED Surface smoothness improved by 19.2%.
7. Drain frequency of SA bath increased from 4 months to 6 months.
8. DM water requirement reduced from 180 KL to 120 KL per annum.
9. Degreasing temperature requirement reduced from 55-65°C to 40-50°C.
10. No Hash mark on the product, Better coating in Box section area also
11. Financial benefit of INR 5.25 Million. Opportunity cost benefit of INR 450 Million.
12. Reduction of carbon footprint as a result of energy consumption reduction.

LEVERAGE OF RESULTS AND EFFECTS; *Describe how you see that the results from the project can be used and leveraged by others. In what way can the project be replicated by others? How and where do you see the project principles and results could be used elsewhere, in other areas or applications/businesses? If the results already have been leveraged to other products, processes, activities, etc. make clear how and what the results are. (Max. 1000 characters)*

There's a possibility of replicating the project to another plant of Ashok Leyland which is under progress now.

This project could easily be replicated to other organizations globally wherever Phosphate Sludge is being generated and there's a significant potential to reduce it. It can be done with minimal investment.

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Scope includes,

- Auto OEMs & Railways where pre-treatment phosphating process happens.
- Consumer Durable & Home Appliance businesses where powder coating is required

IMPORTANCE TO SUSTAINABLE DEVELOPMENT; *Please describe in what way you see that the project results are important to sustainable development. Describe the effects and results on sustainability achieved from the work carried out in the project. (Max. 1000 characters)*

As indicated in the results, the project has led to a more responsible production (SDG 12) within the Ashok Leyland plant and can and will be leveraged to other plants and other organizations. But there are also additional benefits that make the project more valuable overall in supporting sustainable development.
There is a reduction in water usage of 33 % and because of reduction of energy consumption (lower process temperature) our carbon footprint has come down.

USE OF QUALITY MANAGEMENT PHILOSOPY, METHODOLOGY AND TOOLS – LINK BETWEEN APPROACH AND RESULTS – UNIQUENESS AND BREAKTHROUGH

USE OF QUALITY MANAGEMENT PHILOSOPHY, METHODOLOGY AND TOOLS; *Describe how quality philosophy, methodology and tools have been used in the work leading to effects and results regarding sustainable development. It could for example be TQM, six sigma methodology, lean tools, root cause analysis, kaizen activities etc. all encompassed by the "Quality body of knowledge". (Max. 1000 characters)*

We have used Six Sigma DMAIC methodology to solve the problem systematically.

Tools used in the project:

1. Variable type Measurement System Analysis (MSA) – GRR study is performed on titration checking method (Phosphate sludge measurement process) to verify whether the measurement system is capable i.e. project metric data is accurate & precise.
2. Pugh matrix is used to select the best alternative based on criteria.
3. Test of Hypothesis - 2 sample t-test is used to verify whether Mean Phosphate sludge generation is significantly reduced after actions implementation.
4. Test of Hypothesis - 2 sample t-test is used to verify whether Mean Phosphate coating weight is significantly different (before Vs after actions implementation).
5. Process capability study is performed on Phosphate coating weight process (before improvement and after actions implementation) to verify whether our process is stable & capable.
6. Variable Control charts are used to establish the baseline i.e. Mean Phosphate sludge generation and verify whether the process is stable before actions implementation.
7. Variable Control charts are also used to compare Mean Phosphate sludge generation before and after actions implementation and verify whether the process is stable after actions implementation.
8. Risk analysis is performed to understand potential failures with the selected solution and arrive at appropriate risk mitigation plans.

LINK BETWEEN APPROACH AND RESULTS; *Describe how and why the project was planned and executed in the way it was. Describe why certain tools and methods were used and how they supported the project achieving the results planned. (Max. 1000 characters)*

In the absence of a structured methodology like DMAIC, we would have jumped to actions directly. It would have led to wrong decisions. The structured Six Sigma DMAIC methodology helped us in systematically solving the problem without jumping on to the solution. The methodology allowed us to achieve the results in every step of the process. A short overview is given below.

Step-1 Define: helped us in accurately framing / describing the problem, understanding the business case, understanding the gap
between current state and desired state thus choosing appropriate project metric and setting project goals. It also helped us in understanding the resources and support required, setting timelines for the project, and finally preparing the Project charter.
Step-2 Measure: helped us in gaining a superior understanding on the entire process flow, key process input variables (KPIVs), key process output variables (KPOVs) and existing standards verification. It also helped us in establishing the baseline for the

project using control charts. Tools like Variable type Measurement System Analysis (MSA) – GRR study and Variable Control charts helped us in this step.
Step-3 Analyze: helped us in systematically identifying the root causes using tools, Process Capability studies, Test of Hypothesis (2 sample t-test) and Process capability studies.
Step-4 Improve: helped us in selecting the best alternative based on criteria using Pugh matrix. Process capability studies helped us in verifying the capability of the processes i.e. whether we are meeting the specifications.
Step-5 Control: helped us in verifying if improved metric performance reached the target level using tools, Test of Hypothesis (2 sample t-test). Standardization: helped us in establishing and controlling the new practices. helped us in horizontal deployment, customer feedback, financials vetting and appreciation to the team.

UNIQUENESS AND BREAKTHROUGH; *In what way are the results achieved from the project unique and outstanding and in what way do they represent a breakthrough? (Max. 1000 characters)*

The approach taken is a Six Sigma DMAIC improvement methodology but applied in a creative way. The use of Pugh matrix comparison for instance is a tool that is not well known but very useful to compare different alternatives.
Also, with this project we introduced Advent of compact & fine phosphate coating in India. This method was widely used in Japanese auto OEMs and with this project we have made it economically and technically established in India. This can be a breakthrough for many phosphate coating processes in the country.

AGREEMENT AND ATTACHED DOCUMENTS

I agree that the attached summary (One-page summary) is being used by IAQ and the IAQ Think-tank QiPECTT members to promote sustainability development by using quality philosophy, methodology and tools. I agree that this summary also could be published by IAQ on the web.

Signature of responsible person

Attachment 1 (**Required**): One-Page Summary - Summary for publication
Attachment 2 (**Voluntary**): Technical report

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