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Reduction Of Breakdown Time Of CO_2 Welding Machine Through Data Analysis

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Abstract

The primary purpose of the Shielding gas in CO_2 welding is to protect the molten weld from contamination and damage by the surrounding atmosphere. The correct, constant, and steady flow of gas on the weld area is essential for producing a good quality weld and also to prevent the entry of air into the weld area. Insufficient gas can result in porosity in weld seams. This paper focuses on breakdown time and it's frequency of CO_2 welding due to porosity were detected and analyzed by Pareto chart and Cause and Effect diagram. It's affect directly on reducing frequent and high break down time of CO_2 welding machines. The corrective action was taken by data analysis and after implementation, improvements in CO_2 welding process in terms of reduce breakdown time and no porosity observed.

Keywords: Breakdown time, CO_2 welding, Data analysis, Pareto Chart, Porosity

Introduction

CO_2 welding is popularly used for welding mild steel and high strength steel. CO_2 welding is the metal active gas system which is commonly used for welding most structural and alloy steels .CO_2 welding system normally powered with constant voltage source. This process is very versatile in that, by selection of the proper wire diameter and composition it can be used for welding of thin sheet as well as thick plates. For identification of welding defects in CO_2 welding system, statistical approach signature analysis technique can be used [1]. Shielding gas is used to protect

the arc and molten weld, pool from atmosphere oxygen and nitrogen. If not properly protected it forms oxides and nitrites and result in weld deficiencies such as porosity, slag inclusion and weld embrittlement [2]. Porosity (Figure 1) is a collective name describing cavities or pores. It is because of air entrapment in the molten material during welding & some time escape from welding seams. There are many causes which include contamination, inadequate shielding, unstable arc, and arc gap too short & poor welding technique in general. Porosity can be minimized in many different ways – by the proper selection of electrodes and/or filler materials, improved welding techniques, more attention to the work area during weld preparation and a slower speed to allow gasses time to escape. The effects of porosity on performance depend on quantity, size, alignment, and orientation to stresses [4].

Figure 1: Pores in weld seams

The following monitoring of CO_2 welding process parameter when porosity occurred.

S. No.	Parameter	Checking Method	Range	Condition
1	Voltage	Voltmeter	30 -40 V	36 V
2	Current	Ammeter	150-190 A	180 A
3	Wire Speed	Wire Speed Knob	8-10	9
4	CO_2 Pressure	Alarm & Pressure gauge	4 kg/cm^2	4 kg/cm^2
5	CO_2 Flow	Flow meter	22-35 lts/min	30 lts/min

This paper is presented firstly No. of break downs & break down time of CO_2 welding machines in respective it's nature of problem. Pareto chart gives clear idea of the problem about maximum effect of breakdown in CO_2 welding machines and cause and effect diagram added its cause. Data analysis is used here to find out the root cause of the breakdown problem and its improvement.

Problem Selection

The observation as per No. of break downs & break down time of CO_2 welding machines are high, Hence we have selected here CO_2 welding machine for project. The breakdown data have collected from July-2013 to June-2014. Table 1 shows breakdown data for CO_2 welding machine.

Table 1: Breakdown data for CO_2 welding machine

No. of Machines	No of Break Down	Avg. no of B/D per m/c	Break Down Time (in min)	Avg. B/D time per m/c (in min)
12	82	6.88	3798	316.5

Table 2 shows Data sheet for break down time and frequency of CO_2 welding machine and its respective nature of problem.

Table 2: Breakdown time and nature of problem

Sr. No.	Nature of problem	Down time in min	No of break down
1	Porosity	1230	21
2	Pcb defective	832	12
3	low current	400	13
4	Motor problem	418	5
5	Extra wire	385	5
6	Power supply problem	180	7
7	Torch defective	155	9
8	Drive roller problem	128	6
9	Solinoid defective	30	1
10	K2 relay defective	25	2
11	Gas flow meter prob.	15	1
	Total	3798	82

Data Observation

The Pareto chart based on m/c down time

The following observation data (Figure 2) states that Porosity problem adding the maximum time in machine breakdown.

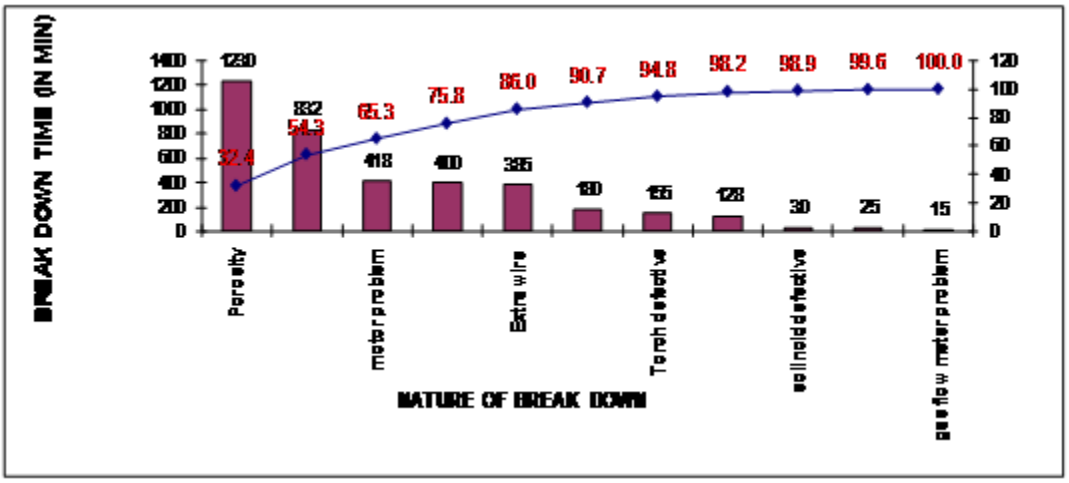


Figure 2: Pareto chart based on m/c downtime

The Pareto Chart (Figure 3) Based on No. of different types of Problems states that Porosity problem is high, so we decided to take action on it.

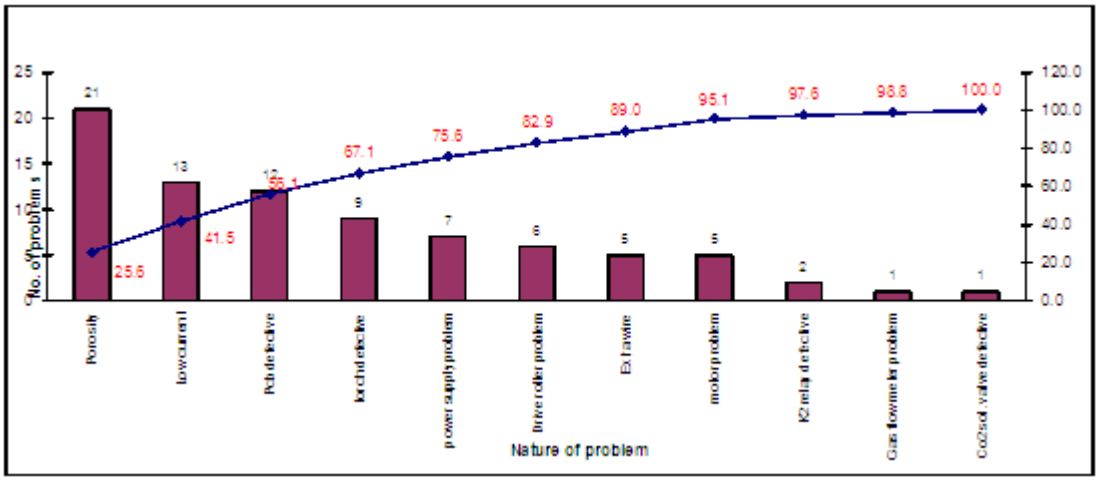


Figure 3: Pareto chart based on different types of problem

Cause and Effect Diagram

The Cause and Effect diagram shows causes of Porosity and its effect.

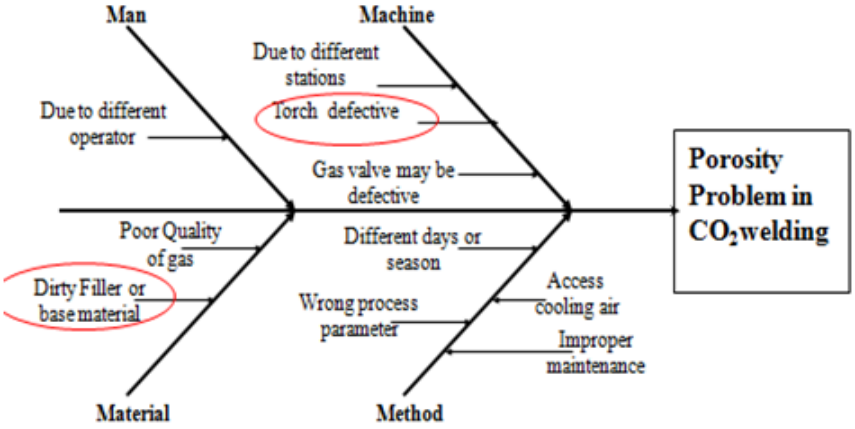


Figure 4: Cause and Effect diagram

Data Analysis

From observation, it is concluded that:

i) Porosity problem is not because of any particular machine or any particular month.

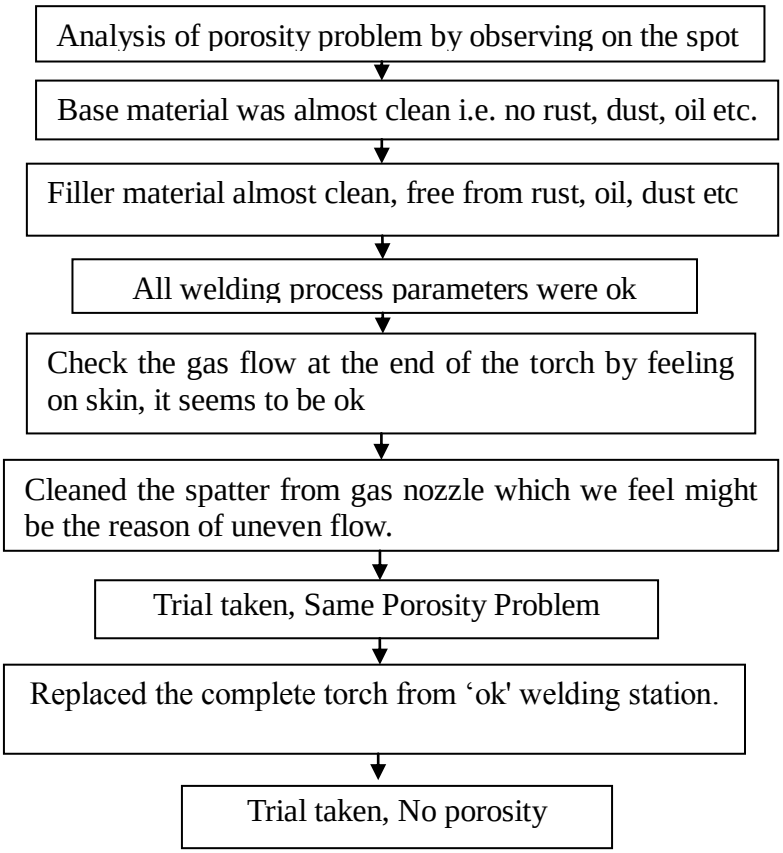
ii) Porosity problem is not because of any particular operator.

But, Porosity problem occurs in all the weekdays. Analysis of preventive maintenance was done and observed that-

i) Preventive maintenance was carried out on weekly basis as per schedule.

ii) All the preventive check point was effectively implemented related with each part of the machine.

Here, observed that, No relation of the porosity problem with the preventive maintenance. The following observation taken to find reason behind porosity:



From above analysis, it confirms that Torch was the reason of porosity. The following Corrective action has been taken:

Table 3: Corrective action

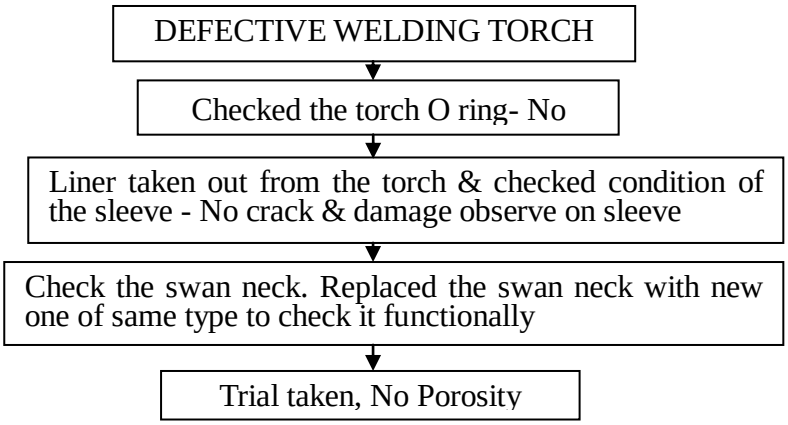
S. No.	Corrective Action	No. of involvements
1	Torch replaced	10
2	Torch + Wire feeder replaced	1
3	Torch replaced + CO_2 solenoid valve cleaned	1
4	Torch replaced + CO_2 flow adjusted	1
5	Torch replaced + Wire role replaced	1
6	Torch replaced + Wind Flow (draft) adjusted	1
7	Torch replaced + Current adjusted	1
8	Wire feeder replaced	1
9	Wire feeder + CO_2 flow adjusted	1
10	CO_2 flow adjusted + power contactor replaced	1
11	CO_2 flow adjusted + drive roll Alignment done	1
12	Earthling cable replaced	1

The above analysis states (Table 3) that only torch replaced 10 times & torch replaced with others combination 6 times whenever porosity problem solved. The final analysis concluded that, Torch play major role in porosity problem.

Analysis of Defective Torch

Figure 5 shows CO_2 welding torch. The analysis of defective torch is done in following way:

Figure 5: CO_2 welding torch



The conclusion from above analysis of defective torch is swan neck is defective. The Swan neck is not repairable.

Analysis of Defective Swan Neck

Swan neck plays major role to supply the even & steady shielding gas flow through gas distribution holes & slots for welding seams. To find the reason of uneven & turbulent shielding gas flow, we try out to observe the gas hole in swan neck. But we can't see because these are covered with metallic & Teflon sleeve. We cut carefully the 3 nos. defective swan neck & found following results (Table 4).

Table 4: Analysis of Defective Swan Neck

Swan Neck	Total no. of holes & slots	No. of hole blockage	No. of slots blockage
Swan neck -1	12	2	5
Swan neck -2	12	5	2
Swan neck -3	12	3	2

The above data confirm that the blockage of holes & slots causes uneven & turbulent flow of gas at the end of swan neck. The Result is Porosity. So we decided to change Swan neck with the new type of swan neck

Interpretation of Results after Implementation

After monitoring of porosity problem for four weeks, observed that no porosity problem were observed. The breakdown data of weld shop & CO_2 welding machine after implementation is:

1) The Breakdown time has drastically reduced to 92 min for weld shop and 60 min for CO_2 welding.
2) Also, number of breakdown for CO_2 welding has reduced from 6.8 to 2.4

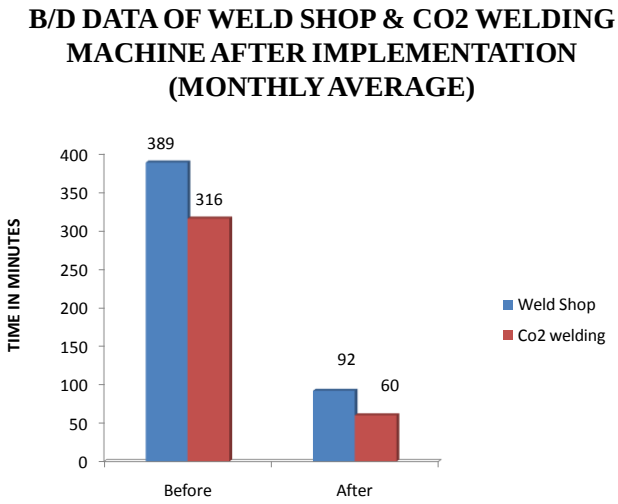


Figure 6: B/D Data in minute of Weld Shop CO_2 welding machine after Implementation

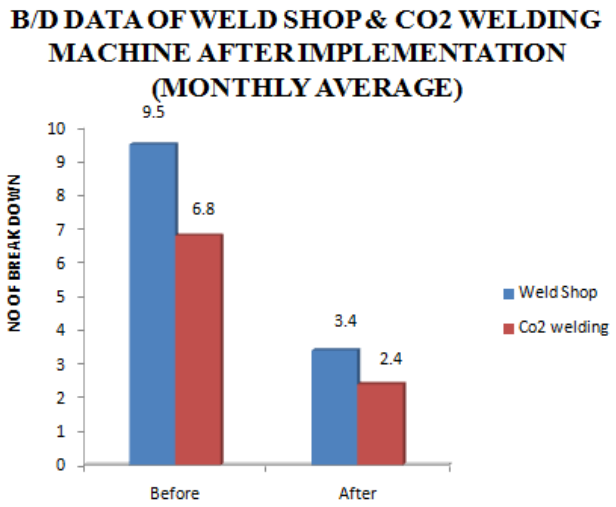


Figure 7: Number of Breakdown of Weld Shop CO_2 welding machine after Implementation

Conclusion

As Porosity can greatly affect weld performance and reducing frequent and high break down time of CO_2 welding machines. For good quality of welding not only sufficient quantity (flow) of CO_2 gas is required but also steady and even flow of CO_2 is must. Through analysis of preventive maintenance, find out the reason of porosity and corrective action has been taken out to reduced porosity. The benefit has been get in terms of, B/D Time has been reduced drastically and there will be reduction in Spares cost.

Indirect benefits:

- Operator fatigue is less due to reduction in frequent breakdowns.
- Improved team spirit

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