Insta`llation of New CSD (Carbonated Soft Drink) RGB (Returnable Glass Bottle) Line with Food Safety Comply and Final Validation

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Abstract— *The basic of this project was installation of new CSD (carbonated soft drink) RGB (returnable glass bottle) line with comply food safety and final validation of line. New manufacturing line installation deals with installation of all equipment and machine require for smooth running and producing CSD for COCA-COLA company (Coca-Cola, Thums UP, Limca) such as conveyer belt, uncasing machine, light inspection station, bottle washer EBI (electronic bottle inspection) machine, Paramix, Filler, Sealer, Date coding machine, caser etc. During installation of machine we have fulfill requirement related to machine, work space, hygienic condition so that machine can work smoothly and deliver safe food product The main concern of doing this project was deliver a safe product to the consumer by applying HACCP and ISO22K. I have done hazard analysis and validation of this new installed line and identify CCP and OPRP which need to control by applying control measure.*

Keywords— Food Safety, Validation, HACCP, CCP, OPRP, CSD, RGB.

I. INTRODUCTION

Coca-Cola (often referred to simply as Coke) is a carbonated soft drink produced by The Coca-Cola Company of Atlanta, Georgia. It was originally intended as a patent medicine when it was invented in the late 19th century by John Pemberton. Coca-Cola was bought out by businessman As a Griggs Candler, whose marketing tactics led Coke to its dominance of the world soft-drink market throughout the 20th century. The name refers to two of its original ingredients: kola nuts, a source of caffeine, and coca leaves. The current formula of Coca-Cola remains a trade secret, although a variety of reported recipes and experimental recreations have been published. The company produces concentrate, which is then sold to licensed Coca-Cola bottlers throughout the world. The bottlers, who hold exclusive territory contracts with the company, produce the finished product in cans and bottles from the concentrate, in combination with filtered water and sweeteners. A typical 12 oz (355 ml) can contains 38g of sugar (usually in the form of HFCS). The bottlers then sell, distribute and merchandise Coca-Cola to retail stores, restaurants and vending machines. The Coca-Cola Company also sells concentrate for soda fountains to major restaurants and food service distributors.(**The Atlanta Journal Constitution2013).**The Coca-Cola Company has, on occasion, introduced other cola drinks under the Coke brand name. The most common of these is Diet Coke, with others including Caffeine-Free Coca-Cola, Diet Coke Caffeine-Free, Coca-Cola Cherry, Coca-Cola Zero, Coca-Cola Vanilla, and special versions with lemon, lime, or coffee. In 2013, Coke products could be found in over 200 countries worldwide, with consumers downing more than 1.8 billion company beverage servings each day. (Bartow J. Elmore 2012).

The Coca-Cola Company and its network of bottlers comprise the most sophisticated and pervasive production and distribution system in the world. More than anything, that system is dedicated to people working long and hard to sell the products manufactured by the company. This unique worldwide system has made the Coca-Cola Company the world's premier soft drinks enterprise. From Boston to Beijing, from Montreal to Moscow, Coca-Cola, more than any other consumer products, has brought pleasure to thirsty consumers around the globe. For more than 125 years, Coca-Cola has created a special moments of pleasure for hundreds of millions of people every day.(**Richard Gardiner 2015).**

Food safety is a scientific discipline describing handling, preparation, and storage of food in ways that prevent foodborne illness. This includes a number of routines that should be followed to avoid potentially severe health hazards. In this way food safety often overlaps with food defense to prevent harm to consumers. The tracks within this line of thought are safety between industry and the market and then between the market and the consumer. In considering industry to market practices, food safety considerations include the origins of food including the practices relating to food labeling, food hygiene, food additives and pesticide residues, as well as policies on biotechnology and food and guidelines for the management of governmental import and export inspection and certification systems for foods. In considering market to consumer practices, the usual thought is that food ought to be safe in the market and the concern is safe delivery and preparation of the food for the consumer. **(WHO 2010).** Hazard analysis and critical control points or HACCP is a systematic preventive approach to food safety from biological, chemical, and physical hazards in production processes that can cause the finished product to be unsafe, and designs measurements to reduce these risks to a safe level. In this manner, HACCP is referred as the prevention of hazards rather than finished product inspection. The HACCP system can be used at all stages of a food chain, from food production and preparation processes including packaging, distribution, etc. **(William at al.2009)**

II. METHODOLOGY

2.1 Water treatment plant

Coca-Cola industry has a unique WATER TREATMENT PLANT with specially designed features which fulfill all the requirement of water throughout the plant. The source water can be used to supply three types of water. raw water, treated water, soft water. The Raw Water is used to form Treated water for Beverage and Syrup preparation and Soft Water for Bottle Washer, Boilers, Cooling Coils and other utility cleaning purposes.

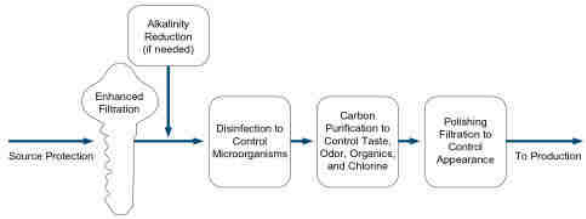

Fig.2.1: Multiple Barrier Treatment (MBT)

We use Multiple Barrier Treatment (MBT) for the preparation of TREATED WATER.

Multiple Barrier Treatment provides a "Safety Barrier" &ensure full compliance to IS 14543. The Multiple Barrier Treatment process has an additional role of organics removal including pesticides. The site for the manufacturing plants is finalized only after the source water has been tested for all requirements of potable water. The analysis is always conducted by independent third party accredited laboratories. The source water is then properly protected and re-tested periodically to ensure that it conforms to international standards. The water is then drawn through sealed pipelines into the storage tank placed in secured water treatment areas of the manufacturing plants.

2.2 Syrup Preparation

Sugar taken from the market and analyze to ensure standard quality The sugar taken by the rotary is delivered into the dumping tank The tank contain Treated water at a temperature of 700C (so that sugar dissolves equally without the formation of any lumps) sugar is added into it and the temperature is raised to 850C through steam. This high temperature is maintained so that all the microorganism are killed. Hyflo Powder added at a concentration of 0.25% to remove all the impurities in the sugar. Carbon Powder added at a concentration of 0.35% to absorb all the impurities. At 850C all carbon is activated and all its pores are open to absorb impurities. Contact time at 850C in the dumping tank is half an hour. Then filtered through PFF and then cool at 20-250C and mix desired flavor.

2.3 Proportioning and Filling

Grain less corn cobs (GLCC) was chopped into small pieces (1-2 cm) with sharp knife and collected

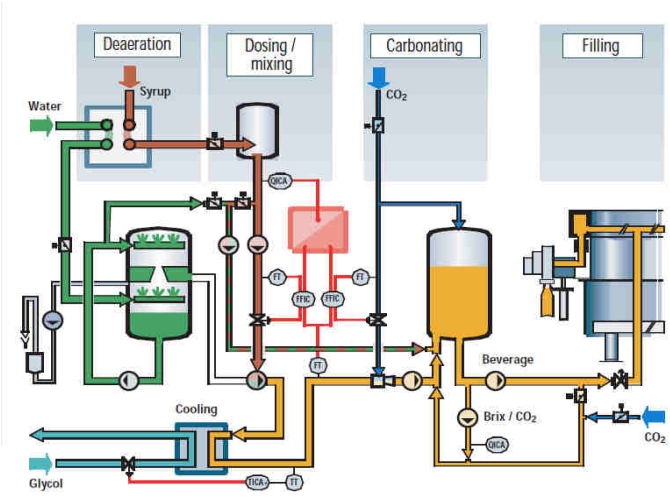

Fig.2.2: Proportioner.

Flavoured Syrup and Purified Treated Water is blended with pure Carbon dioxide to produce a carbonated beverage which is then filled into clean bottles.The Syrup and Water are mixed together in the correct ratio at the proportioner to produce the finished beverageAt this stage the final ingredient Carbon- di-oxide is dissolved in the finished beverage at the proportioner Finally the ready beverage enters the clean bottles at the fillerThe filled bottles are sealed at the capper or crowner.

2.4 Hazard analysis criteria & control measure assessment.

HACCP system is science-based and uses a systematic approach to the identification of specific hazards and measures for their control or prevention to ensure the safety of food. The preventive measures must be described in detail and people who have to execute them must be trained. HACCP involves careful recording of all details and actions in order to provide documentation that the system is in operation and in full control of all hazards in food processing. Codex Alimentarius Commission, as guidance, define the 7 principles and 12 steps that must be applied during the development of the HACCP plan and implement the HACCP system.

The seven principles of HACCP based and to ensure safe and correct in all aspects of food production and processing are:-

1. Conduct a hazard analysis.
2. Determine the Critical Control Points (CCPs).
3. Establish critical limit(s).
4. Establish a system to monitor control of the CCP.
5. Establish the corrective action to bet taken when monitoring indicates that a particular CCP is not under control.
6. Establish producers for verification to confirm that the HACCP system is working effectively.
7. Establish documentation concerning all procedures and records appropriate to these principles and their application.

The 7 basic principles are implemented into the system through the 12 steps:

1. Assemble HACCP team
2. Describe product
3. Identify intended use
4. Construct flow diagram
5. On-site confirmation of flow diagram
6. List all potential hazards associated with each step, conduct a hazard analysis, and consider any measures to control identified hazards (Principle 1)
7. Determine Critical Control Points (Principles 2)
8. Establish critical limits for each CCP (Principle 3)
9. Establish a monitoring system for each CCP (Principle 4)
10. Establish corrective actions (Principle 5)
11. Establish verification procedures (Principle 6)
12. Establish Documentation and Record Keeping (Principle 7)

All the identified hazards will be routed through MATRIX A for their probability & severity.Then identify the significance of the hazards as per MATRIX B. All non significant hazards are measured as PRP. The Assessment / Categorization of Control Measures for identified all SIGNIFICANT hazards will be determined as OPRP & CCP through MATRIX C.

MATRIX A

Table.2.1: Categorization of probability and severity

Probability		Severity	
High	Could occur Daily or once up to month (Most of Certain to happen)	Critical	Illness/injury leads to death
Medium	Could occur more than 30days up to a year.	Serious	Illness/injury/Sickness leads to prolonged hospitalization
Low	Could occur more than a year or no past record of occurrence.	Major	Illness/injury/Sickness leads to hospitalization for a very short period (1-7 days)
		Minor	Mild/Minor Illness/injury/Sickness

MATRIX B

Table.2.2: Risk of hazard

Probability				
High	Non Significant	Significant	Significant	Significant
Medium	Non Significant	Significant	Significant	Significant
Low	Non Significant	Non Significant	Non Significant	Significant
	Minor	Major	Serious	Critical

Severity of Hazard

MATRIX C

Table.2.3: Control Measure Assessment relevant to Significant Hazards

Probability of Failure of Control Measure (1)	
High (3)	*Often : once in a month*
Medium (2)	*Occasionally : once in 6 months*
Low (1)	*Marginal: maybe once in a year*

Consequence in case of failure of Control Measure (2)	
High (3)	Definitely affect end product
Medium (2)	May affect end product
Low (1)	Marginal impact on end product not affecting into food safety
Feasibility for Monitoring (3)	
High (3)	Continuous
Medium (2)	At defined Frequency
Low (1)	Not Possible to monitor
Impact on hazard Control (4)	
High (3)	Prevent
Medium (2)	Eliminate
Low (1)	Reduce
Is there a successive control measure? (5)	
Yes	Add 0 points
No	Add 1 point
Is Control measure specifically designed? (6)	
Yes	Add 1 point
No	Add 0 point
Is there Synergetic effect with other CM? (7)	
Yes	Add 0 point
No	Add 1 point

Total score is the addition of individual score of all 7 parameters. If Total score is ≤ 9, Control Measure will be managed through OPRP. If Total score is > 9, Control Measure will be managed through CCP (HACCP Plan)

2.5 Quality Validation

All physiochemical analysis carried out as per IS standard such as Chlorine Test, Total Hardness, Calcium Hardness, Total Alkalinity, Chloride Test, Sulfate Test, Turbidity Test, PH Test, Alkalinity test, Methylene Blue Reagent Test, Caustic Carry Over Test, Stabilon Mex Power, Brix, Inverted BRIX, Gas Volume, Crown Crimping.

III. RESULT AND DISCUSSION

3.1 Installation of new line

There are four main section deal with new lines. Water treatment plant installation. Syrup preparation section. Bottle washer or container preparation section. Proportioning and filling. All the machine, tank, conveyer etc. installed successfully as per standard. Soft drink production starts with a pure source of water. Regular soft drinks contain 90 percent water, while diet soft drink may contain up to 99 percent water. Drinking water often includes trace amounts of various elements that effect in taste. Bottlers use filtering and other treatment equipment to remove residual impurities and standardize the water used to make soft drinks, so that soft drinks taste the same nationwide. So the water treatment plant installed to produce standard quality water as per coca- cola standard. Syrup preparation is an important part of soft drink industry. All the equipment utensil such as tank, pipe line, filter press, plate heat exchanger etc. are installed as per Coca-Cola standard. Bottle washing is a section where we prepared packaging material for soft drink packaging. The most important thing in soft drink industry is we use a glass bottle multiple times by cleaning it. So we have to insure the quality and hygienic condition of bottle. By installing bottle washer we are maintain good quality bottle. In bottle washer we have maintain time, temperature, chemical concentration, and mechanical action for better performance of bottle washer. Flavored Syrup and Purified Treated Water is blended with pure Carbon dioxide to produce a carbonated beverage which is then filled into clean bottles. The Syrup and Water are mixed together in the correct ratio at the proportioner to produce the finished beverage At this stage the final ingredient Carbon- di-oxide is dissolved in the finished beverage at the proportioner Finally the ready beverage enters the clean bottles at the filler. The filled bottles are sealed at the capper or crowner.

3.2 Implementation of Food Safety (HACCP) system on installed line.

After installation of line each and every step are covered through hazard analysis.

Table 3.1 Hazard analysis of process

Step No.	Process	Type of Hazard	Hazard Description	Source	Risk analysis			Control Measure	Justification of Severity	Justification of Probability
					Poba bility	Sever ity	Over all Risk			
Water Treatment										
1	Water intake and storage	P	Sand Particals	Storage tank	Low	Minor	non significant	Tiling in side of the Storage tank	Mild effect of Health so the the Severity is rated as MINOR.	Study of internal and external report no Past History of occurrence so the probability is LOW
		C	No Hazard							
		B	Mesosphilic (Total) Count as indicator"	Storage tank and condtion	Medium	Serious	significant	Maintain 3 to 5 residual Cl2	Illness leads to prolonged Hospitilization . Infectious diseases caused by Mesophilic & pathogenic bacteria, viruses and parasites are the most common and widespread health risk associated with water including typhoid(salmonella sps.) ,cholera (vibrio cholerae), .Diarrhoea diseases caused by E coli , staphylococcus aureus causes pneumonia& meningities(reference WHO guidelines) Causing illness .i.e. SERIOUS	As per Study of yearly External microbiological reports all parameters found with in specification could occur more than 30 days , So the probability is MEDIUM.

Table:- 3.2 Selection of control measure

STEP	*Process Name*	*HAZARD Ytpe*	*Control Measure*	*Is control measures Validated. Give (Yes /No)*	*Probability of failure of control measure (1)*	*Consequence in case of failure of Control measure (2)*	*Feasibility of monitoring (3)*	*Impact of hazard Control (4)*	*Is there a Successive control (5)*	*Is control measure specifically design (6)*	*Is there any synergistic effect with other CM? (7)*	*Total Score 1+2+3+4+ 5+6+7)*	*CCP / OPRP*
1	Raw Water intake and storage	Biological	Maintain 3 to 5 residual chlorine	Yes	1	3	2	1	0	1	1	9	OPRP

Table 3.3: FSMS plan for CCP

CCP	Hazard	Control Measure	Critical Limit	Action Limit	Target Limit	Monitoring				Correction	Corrective Action
						How	When	Where	Who		
CCP 1	B:	.	3-5 PPM	3.5 & 4.5 ppm Chlorine	4 ppm chlorine	PI-SOP-3.6.2.2.4.	every Hrs	At Clear Water Tank	Chemist and WTP operator	Stop the suuply. Inform to QAM. If less than 3 ppm, then hold the tank and use in backwash and drain the water from ACF to process line. if more than 5ppm,Stop dosing of chlorine and monitor Chlorine till it reaches 5 ppm.	1. Check the concentration of calcium hypochlorite stock solution & dosing system. 2.Hourly monitoring of dosing volume.

Responsibility and authority	Records	Action with regard to the product	Verification			Validation		
			How	When	Who	How	When	Who
FSTL & QAM	COCA-COLA FORM	Identify & segregate the product manufactured during nonconformance & hold the product for that particular one hour prior and after the non conformance observed, then ensure it meets the microbiological & sensory specification otherwise reject the product	Review water and weekly micro reports and online checking	Quarterly	Verification Team	Micro Tests	At starting and When change in equipment,product or change in line	Validation Team will validate Microbiological tests & records, (Online testing Microbiological test reports
						Validation Program	At starting and When change in equipment,product or change in line validation procedure will be made	Validation Team

3.3 Final quality validation

3.3.1 In house Tests Performed Of Treated Water

Table.3.1: Analysis report of treated water

PARAMETER	*SPEC.*	*RESULT*		
Taste	*Nm*	*Nm*	*Nm*	*Nm*
Appearance	*Nm*	*Nm*	*Nm*	*Nm*
Odor	*No off odor*	*No off odor*	*No off odor*	*No off odor*
M alkalinity	*<85mg/L*	*40*	*48*	*46*
Turbidity	*<. 05 NTU*	*0.01*	*0.01*	*0.01*
PH	*6.5-8.5*	*7.42*	*7.31*	*7.52*
Total hardness	*<100ppm*	*72*	*65*	*78*
Total dissolve solid	*<500ppm*	*152*	*130*	*158*
Sulphate	*<250ppm*	*107.22*	*102.55*	*104.20*
Chloride	*<250ppm*	*54.26*	*56.72*	*56.30*
Total Chloride & Sulphate	*<400 ppm*	*161.48*	*159.27*	*160.50*
Iron	*<0.1ppm*	*.03*	*.04*	*.03*

3.2 In house Tests Performed Of syrup**.**

PARAMETER	**SPEC.**	**RESULT**		
Taste	**Nm**	**Nm**	**Nm**	**Nm**
Appearance	Normal and free from any foreign matter.	Normal and free from any foreign matter.	Normal and free from any foreign matter.	Normal and free from any foreign matter.
Odor	No off odor	No off odor	No off odor	No off odor
Brix	As/CCI	ok	ok	Ok
Temp	<30oC	23	22	22

Odor	No off odor	No off odor	No off odor	No off odor
Brix	As/CCI	ok	ok	Ok
Temp	<30oC	23	22	22

3.3.3 In house Tests Performed On bottle washer parameter.

Table: 3.3 Analysis report of bottle washer.

PARAMETER	**SPEC.**	**RESULT**		
Caustic %	2.8+_0.2%	2.8	2.9	2.9
Carbonate %	<0.8	0.23	0.23	0.24
Stabilon Max	0.2-0.3	2.3	2.1	2.5
Free Cl2 in final rinse water	1-3 ppm	2	2	2
Temp	<30oC	23	22	22

3.3.4 In house Tests Performed On finished product.

Table.3.4: Analysis report of finished product

PARAMETER	SPEC.	RESULT		
Taste and Odor (Flavor)	Nm	Nm	Nm	Nm
Appearance	Normal and free from any foreign matter.	Normal and free from any foreign matter.	Normal and free from any foreign matter.	Normal and free from any foreign matter.
Odor	No off odor	No off odor	No off odor	No off odor
Brix	10.37± 0.15	10.35	10.40	10.38
Carbonation	3.75 ± 0.25	3.80	3.82	3.4

IV. CONCLUSION

The entire machine installed are operated successfully as per suppliers manual and found satisfactory. The product produce were found satisfactory in all aspect. For deliver safe product to the consumer HACCP system implemented to remove or eliminate or reduce up to expectable limit of the food safety hazard. Under HACCP System 2 CCP and 4 OPRP determined where we have to more focus to maintain. For all CCP and OPRP critical limit and control measure are established to control the food safety hazard. The Physico-chemical property of product such as Gas volume (GV), Brix, taste, odor, and appearance found as per Coca-Cola specification.

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