Kreator
Volume 10, Number 1, Tahun 2023 pp. 14-21
P-ISSN: 2354-9505 E-ISSN : 2548-9542
Open Access: https://doi.org/10.46961/kreator.v10i1.758

Analysis of Residual Solvent Problems In Cooking Oil Packaging Products at PT X

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ARTICLE INFO

Article history:
Received June 24, 2023
Revised July 18, 2023
Accepted July 25, 2023
Available online July 31, 2023

Kata Kunci:
Residual Solvent, Gas Chromatograhy, Quality Contro, Dry Lamination
Keywords:
Residual Solvent, Chromatograhy Gas, Quality Contro, Dry Lamination

ABSTRAK

Proses produksi pencetakan kemasan tidak dapat dipisahkan dari masalah yang mempengaruhi hasil produk tersebut, dan residu pelarut adalah salah satunya. Kontrol kualitas atau quality control diperlukan dalam suatu bisnis untuk mencapai hasil yang diinginkan dan meminimalkan masalah agar produk tersebut dapat dijual kepada pelanggan. Kualitas produk memiliki beberapa kelemahan, seperti residual solvent, sealing dan bocor. Selain kekurangan yang telah disebutkan, titik kritis terpenting adalah tingginya kandungan sisa pelarut (residual solvent). Cara mengatasi masalah pada titik kritis sisa pelarut adalah dengan membersihkan chamber, exos dan chiller serta menaikkan suhu chamber agar hasil penguapan sisa pelarut tetap, dan pemeriksaan kromatografi gas untuk membantu verifikasi sampel. Berdasarkan masalah yang teridentifikasi, hasil kualitas produk di PT X dapat mengurangi masalah pada produk dengan residu pelarut yang tinggi. PT X adalah produsen, pemasar dan distributor produk minyak goreng.

ABSTRACT

The packaging printing production process cannot be separated from the problems that affect the product yield, and solvent residue is one of them. Quality control or quality control is needed in a business to achieve the desired results and minimize problems so that these products can be sold to customers. Product quality has several weaknesses, such as residual solvent, sealing and leaking. Apart from the disadvantages mentioned, the most important critical point is the high residual solvent content. The way to solve the problem at the critical point of remaining solvent is to clean the chamber, exos and chiller and increase the temperature of the chamber so that the evaporation of the remaining solvent remains, and gas chromatography examination to assist in sample verification. Based on the problems identified, product quality results at PT X can reduce problems in products with high solvent residues. PT X is a manufacturer, marketer and distributor of cooking oil products.

1. INTRODUCTION

In the cooking oil packaging process, the quality of each package is prioritized. According to Nurkholiq (2019), product quality is generally influenced by 4 main factors, namely humans, methods, machines and materials used during the process which will influence all processes to determine the quality of a product. Frequently encountered problems in the industrial world, namely the mismatch between the planned form and the resulting form of production (Kana et al, 2021). Defective packaging and product content quality that does not meet standards will affect the company's image, resulting in a decrease in consumer purchasing levels. In order to prevent this from happening, it is necessary to have QC (Quality Control) in the production process to ensure that all products comply with the standards applicable in the company and to keep the quality of the packaging the same.

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Currently, the critical point in the cooking oil packaging production process at PT X is the residual solvent content. Residual solvent itself is a collection of solvents in a solution and can absorb liquids, gases or solid objects which are often used in industrial processes (Johnston, 2013). High residual solvents will contaminate cooking oil packaging and affect the contents of the product packaging. Therefore, it is necessary to identify the causes of high residual solvent in the cooking oil packaging production process. We identified several problems that existed in the cooking oil packaging production process, namely the WIP process for cooking oil packaging on the Dry Lamination machine which experienced problems, namely finding a thickness that did not comply with the standards, finding wrinkles, finding loose ends and finding residual solvents that did not meet the standards. The problem that often occurs is residual solvent that does not meet standards and a solution has not been found. Therefore, in this research we want to present a solution to the residual solvent problem for cooking oil packaging products at PT X to comply with standards.

2. METHOD

The research methods used include Preparation, Implementation and Evaluation as shown in Figure 1. In the preparation stage what is needed is to wait for the PO (Packaging Order) which must then be signed by Quality Control and the head supervisor there and then prepare the WIP materials for the process. beforehand by recording the lot number in the report list so that it can be tracked in the previous process when a problem occurs. The process of preparing the glue for the process involves checking the viscosity and when the process wants to run, the dry glue will be checked by Quality Control to determine whether the process can be run at this stage.

The next stage of implementation is that the machine will be run according to the standard speed of the machine countermeter and WIP printing/PET with a thickness of 12µ will be laminated with NYLON film with a thickness of 15µ which is called Dry lamination 1, then it will be laminated again with a machine from lamination process 1 to lamination 2, namely LLDPE and enters the rewinder roll in the machine process section and maintains the stability of the machine and the film connection during the splasing process on the film so that it continues in a continuous process. The final evaluation stage includes sampling of cooking oil packaging and is carried out by examining the sample by gas chromatography. If there is a non-compliance with the standard, the film will be re-checked and moved to identification using the seven tools method and repaired by a technician. Products that are good and comply with the standards that have been determined will be continued at the next stage of the process.

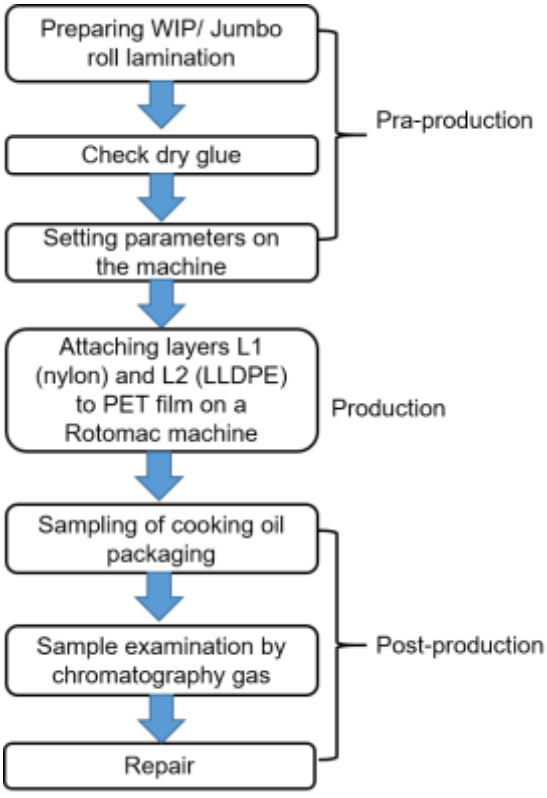

Figure 1. Research Method

3. RESULT AND DISCUSSION

In this research, the residual solvent problem in cooking oil packaging products has been successfully identified. Identification was carried out in the WIP process for cooking oil packaging on a dry lamination machine using a Rotomec machine at PT X starting from pre-production, production to post-production. The pre-production process begins by preparing the WIP/Jumbo roll lamination by recording the lot number in the report list so that it can be tracked in the previous process when problems occur. The dry glue preparation process is also carried out by checking the viscosity to determine whether the process can be carried out at this stage. Next are the parameter settings on the Dry Inline machine with parameters as shown in Table 1. The parameter settings carried out are for WIP printing/PET with a thickness of 12µ, NYLON film with a thickness of 15µ and LLDPE with a thickness of 130µ.

Furthermore, observations were made on the production process of cooking oil packaging using the dry lamination process. At this stage, the residual solvent was checked on the cooking oil packaging by sampling. Residual solvent itself is a solvent in a solution and can absorb liquids, gases or solid objects which are often used in industrial processes. Next, examine the sample using gas chromatography.

Table 1. Dry Inline machine parameters (Composition: PET 12µ /PR/NYLON 15µ/LLDPE 130µ).

	DL 1	DL 2
	PET	PET/NYLON
	NYLON	LLDPE
Unwinder unit 1		
line speed	150 ±10	150 ±10
Unwinder tension	9 ±2	16±2
Corona treatment	-	-
Unwinder unit 2		
Corona treatment	-	-
Unwinder tension	6±2	7±2
Unwinder tension	8±2	7±2
Treatment side	-	in/out
Treatment level	52	38
Rewinder unit		
Rewinder tension	-	12±2
Lay on Preasure	-	2±0,5
Taper tension	-	80±10
coating unit		
unit chamber 1	80±5	80±5
unit chamber 2	85±5	85±5
unit chamber 3	90±5	90±5
Coating tension daw	12±2	28±2
rubber pressure		
opside (BAR)	1,5±0,5	1,5±0,5
rubber pressure		
moron (BAR)	1,5 ±0,5	1,5 ± 0,5
DO PRESSURE (BAR)	1,5±0,5	1,5±0,5
Lami press	4±1,5	4±1,5
Lami heating	65 ± 5	80±5
Lami Coating	20±2,5	20±2,5
Viscosity Glue	17± 1	16,5±25

Sample examination was carried out on 2 liter packaging of brand X cooking oil produced by PT X. The results of the residual solvent examination of several cooking oil packaging samples are shown in Table 2. The data was taken in the production period January-February 2022. The inspection results showed that there were several samples of cooking oil packaging that had high levels of residual solvent. When carrying out the Dry laminate production process, the production department is always faced with various problems, one of which is high residual solvent, this problem is usually only discovered after checking from the Quality Control (QC) department.

If the residual solvent level is high, the sample will be rejected (R), if the solvent level is still within reasonable limits, the sample will be given a pass mark (P), which means the sample has passed quality control and is ready to be distributed to consumers. During the production process, residual solvent is used for the addition process, but there is a standard limit for residual solvent levels. The

standardization of determining permitted residual solvent usage limits refers to the Singapore standard SS 459: 1999 concerning residual solvents in packaging materials.

Finally, an analysis of the problems that occurred was carried out using the seven tools method and then improvements were made. When carrying out the dry laminate production process, the production section is always faced with various problems depending on several different causal factors in each Quality Control discovery and these problems can be solved in different ways and the expertise of operators and technicians on the machine but the main problem that we want to solve is The causes of high residual solvent are raised and what factors are used to evaluate improvements.

Quality Control is an important factor that can also influence the production process of cooking oil packaging using gas chromatography and how the analysis process is appropriate when calculating the sample area when injected with air pressure. As well as the calculation factor from a Quality Control person whether the method is in accordance with the WI (work instruction) which has been adjusted and calibrated at the time of use. The following are several factors that cause and influence the quality results of WIP or cooking oil packaging, explained in the Fishbone Diagram in 7 (seven) basic Quality Tools in Figure 2.

Table 2. The results of the residual solvent examination of several cooking oil packaging samples

No.	No. Lot	Residual Solvent (g/m2)	STATUS	No.	No. Lot	Residual Solvent (g/m2)	STATUS
1	P1J273EX02	10,93	R	37	B1K145DX10	30,03	R
2	B1K035BX03	3,93	P	38	P1K083EY18	3,73	P
3	B1K035BZ07	4,76	P	39	P1M093EZ10	0,97	P
4	B1K025BZ08	2,86	P	40	B1J245AX08	19,04	R
5	B1K025BZ09	4,15	P	41	B1K025DX02	13,51	R
6	B1K155DX09	69,67	R	42	B1K015DX03	11,64	R
7	B1K145DX05	16,55	R	43	B1K145DX03	12,97	R
8	B1K145DX06	20,47	R	44	B1K145DX04	12,6	R
9	B1K035BZ08	5,39	R	45	B1K145DY01	12,54	R
10	B1K155DX05	83,69	R	46	B1K025DZ03	24,84	R
11	B1K155DY07	12,46	R	47	B1K035BX02	6,6	R
12	B1K155DY06	1,22	P	48	B1K135DX07	8,25	R
13	B1K155DX06	95,73	R	49	B1K025DX07	4,6	P
14	B1K155DY04	9,07	R	50	B1K025AX10	1,18	P
15	B1K145DY08	2,28	P	51	B1K025AX08	6,34	R
16	B1K145DY07	11,54	R	52	B1K025AX09	14,83	R
17	B1K025DY14	25,25	R	53	B1K025AX07	5,46	R
18	B1K015AY03	20,28	R	54	B1K025DX10	0,9	P
19	B1K015AY02	14,47	R	55	B1J305DY06	5,92	R
20	B1K025DX05	7,28	R	56	B1J305DZ05	5,2	R
21	B1K015AY04	32,04	R	57	B1K035BX04	15,06	R
22	B1K025AX06	7,38	R	58	B1K025DX08	4,73	P
23	B1K025DX13	13,4	R	59	B1K025AX11	0,53	P
24	B1K015AY01	14,47	R	60	B1J265AZ08	23,25	R
25	B1K145DX07	10,03	R	61	B1K025AX12	14,46	R
26	B1K145DY08	1,22	P	62	B1K025DX06	8,25	R
27	B1K025BZ01	15,35	R	63	P1M093EY04	1,72	P
28	B1K025BZ02	5,21	R	64	P1K123EY06	1,26	P
29	B1K145DX08	17,51	R	65	P1M093EY15	3,06	P
30	B1K135DX06	40,55	R	66	P1M093EY08	1,82	P
31	B1K155DY01	11,06	R	67	B1M275EY01	0,92	P
32	B1K145DZ01	0,8	P	68	P1M213EZ01	1,63	P
33	B1K145DY09	1,48	P	69	P1M093EZ04	1,12	P
34	B1K135DZ02	3,59	P	70	P1M213EZ02	1,15	P
35	B1J265AX05	4,09	P	71	P1M213EZ02	1,79	P
36	B1K145DX09	1,25	P	72	P1J263EX27	21,22	R

From a problem, when we have found the root of the problem using fishbone, we can conclude what can be done in terms of handling these 4 factors, such as materials, methods, labor and also machines which are the root of the problem. Of the 4 problem factors, the solution to each factor is as follows: 1) Material factors such as glue which does not evaporate evenly and how to overcome this: changing the viscosity of the previous glue from 14-16 to 13-15 which is more fluid is the determining factor in making the glue easy to evaporate during production or aging time that has been determined for the product as well as changing the composition of the glue used or using an alternative glue composition to reduce the planned reduction in the desired process by previously using 6680 and 3000 to 323 and 3000 in the composition; 2) Method factors such as not being in accordance with the SOP (standard operating procedures) then the way to overcome this is to carry out retraining and the SOP readers used so that they understand and comply with what has been set by the company and reduce the occurrence of deviations and checking samples must use standards that have been established.

Determined by using gas chromatography or other checking standards and making WI in every checking work process; 3) Machine factors such as the chamber not functioning properly and how to overcome this by cleaning the chamber before the production process of a product. Routine and periodic cleaning is carried out to maximize the heating that occurs in the chamber of the machine so that it can continue production. Changing the temperature in the machine chamber is also a determinant to maximize the production process by using chamber 1 which is 80°c, chamber 2 is 85°c, and chamber 3 is 90°c to use a chamber with a temperature of chamber 1 which is 85°c, the temperature of chamber 2 namely 90°c, and the temperature of chamber 3, namely 95°c, aims to evaporate the air when the heat is produced so that the maximum glue process evaporates and dries more quickly and then the problem of the cooling roll not functioning properly so the way to overcome this is by repairing and cleaning the process before production both on a regular basis and a regular schedule is also arranged to do so, as well as carrying out the cooling roll temperature no more than that which has been determined by the number 20 ± 2.5 for each cooling both stage 1 and stage 2 so that the cooling process is faster and drying of the glue also occurs maximally, finally the problem of Gas Chromatography not being verified.

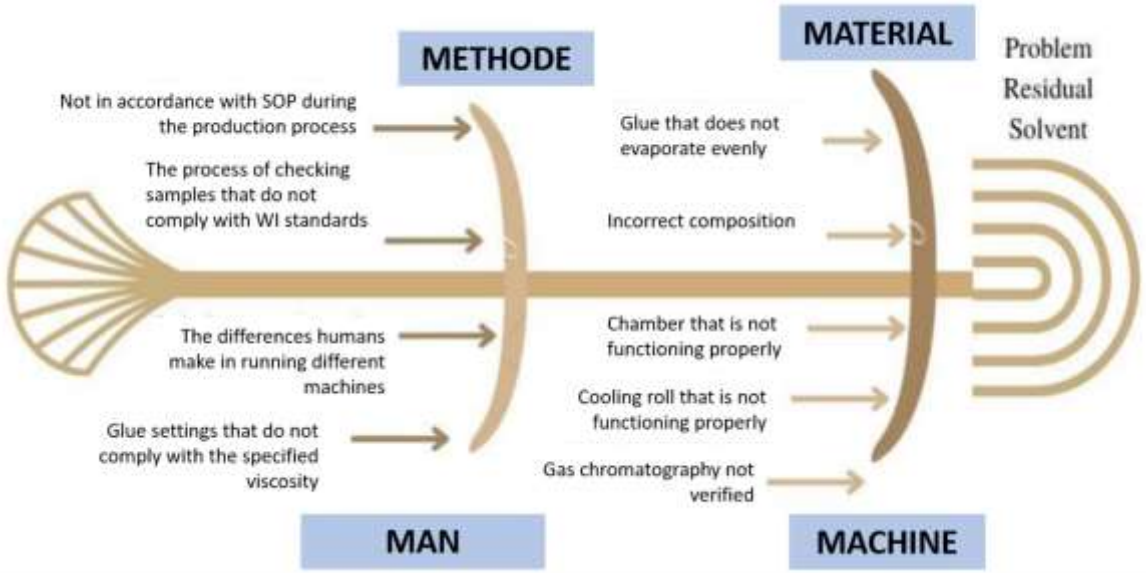

Figure 2. Fishbone Diagram

How to overcome this by verifying with pure EA liquid or the composition of other solvent solutions to be injected so that the results shown on the gas chromatography are whether the readings are in accordance with the injection experiment of a few microns to find out whether the results are appropriate; 4) Labor/man factors, for example the problem of human differences in running machines, how to overcome this, training is carried out and there are QC and Production supervisors to monitor that processes that do not comply with procedures do not occur. After handling the identified problems, the Quality Control process was checked again using gas chromatography and the data obtained showed that the total amount of residual solvent had decreased (it was in

accordance with the standards set with a maximum value below 5 so as not to affect the product results in in the packaging and there is no smell on the packaging). The following data shows the results of sample analysis after improvements, shown in Table 3.

Table 3. Results of residual solvent analysis after repairs were carried out

No.	No. Lot	Residual Solvent (g/m2)	STATUS	No.	No. Lot	Residual Solvent (g/m2)	STATUS
1	B2C258DY304	3,08	P	33	B2C308EZ104	4,6	P
2	B2C28AZ10	1,2	P	34	B2C308AX304	4,81	P
3	B2C298AZ101	2,45	P	35	B2C308EX204	2,95	P
4	B2D048AX108	2,45	P	36	B2C288AZ201	1,45	P
5	B2D048AY303	2,81	P	37	B2C288AZ10	1,2	P
6	B2D048AZ206	3,17	P	38	B2C288AY207	1,88	P
7	B2D048AZ105	2,25	P	39	B2C258DY304	3,08	P
8	B2D058AX105	1,67	P	40	B2C248AZ402	1,59	P
9	B2D058AY202	1,15	P	41	B2C255DY01	1,29	P
10	B2D048EY	1,67	P	42	B2C258AX103	2,12	P
11	B2D048EY	3,94	P	43	B2C248AZ204	3,76	P
12	B2E048EY 301	2,31	P	44	B2C245BZ01	4,97	P
13	B2D048EY301	2,65	P	45	B2C248AY107	3,88	P
14	B2D048EY301C	2,17	P	46	B2C198BZ401	1,44	P
15	B2C318EZ301	1,24	P	47	B2C178BZ402	3,3	P
16	B2C318EZ 203	1,4	P	48	B2C178AZ302	1,4	P
17	B2C318EZ	1,4	P	49	B2C178AX101	3,57	P
18	B2C318EY 302	4,49	P	50	B2C158AZ201	4,02	P
19	B2C318EZ203	3,25	P	51	B2C148AZ101	1,49	P
20	A12	2,61	P	52	B2C138AZ202	3,65	P
21	B2C238AX205	1,92	P	53	B2C128AX401	2,31	P
22	B2C238AX205 CR	2,53	P	54	B2C128AX204	4,65	P
23	B2C238AX205	1,06	P	55	B2C128AX103	3,87	P
24	B1K05B204	4,91	P	56	B2C118AY108	1,37	P
25	P2D123EX07	1,5	P	57	P1K123EY11	1,16	P
26	B2D048AY101	2,42	P	58	P1K123EY19	1,37	P
27	B2D048AX	1,83	P	59	B2CO18CX305	4,41	P
28	B2D018EZ	1,83	P	60	B2C018CZ102	1,64	P
29	B2D018EY302	3,38	P	61	B2C018CX409	1,62	P
30	B2D018DX103	2,78	P	62	B2C018CX	3,8	P
31	B2C318DZ104	2,63	P	63	B2B248C6402	1,66	P
32	B2C318DZ	3,35	P	64	B2B248CZ101	2,03	P

4. CONCLUSION

Based on the analysis of the residual solvent problem that has been carried out, a solution has been found to prevent the occurrence of high residual solvents, namely by regulating the use during the process of adding EA (ethylene acetate) as well as changing the material and temperature settings on the machine during the production process and determining standards for limits on the total use of residual solvent so that it does not occur, exceeds the limits that have been determined by referring to SS: 459: 1999. This is also proven by data that the reduction in high solvent residuals has decreased and is in accordance with the standards.

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