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TIME EFFICIENCY IN THE PAINT PRODUCTION PROCESS

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OUTLINE

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- EXPERIMENTS AND RESULTS
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INTRODUCTION

- Paint production involves several stages to achieve high quality from raw materials.
- Each step—especially mixing and grinding—affects the final paint properties.
- Efficiency is a key challenge in the paint industry.

PAINT PRODUCTION PROCESS

- Paint is typically composed of a combination of raw materials such as binders, pigments, solvents and additives.
- Carefully selected materials are processed to achieve the right paint characteristics.
- Paint production includes **pre-mixing**, **grinding**, and **post-addition** to create a uniform mixture.

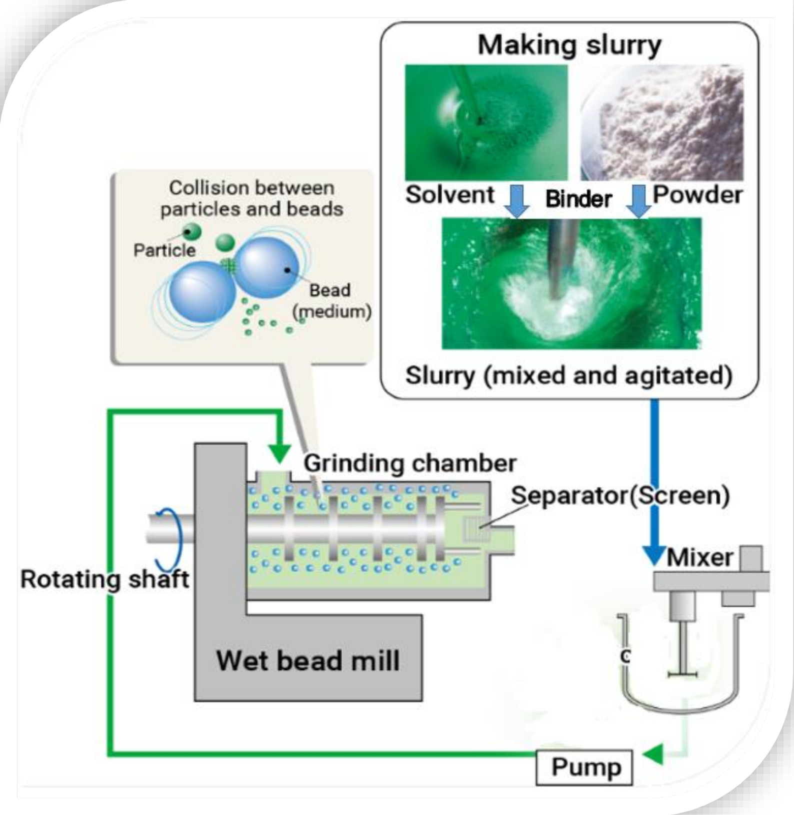

Figure 1. *Bead Mills That Offer Nanotechnology*, Ashizawa Finetech Ltd.

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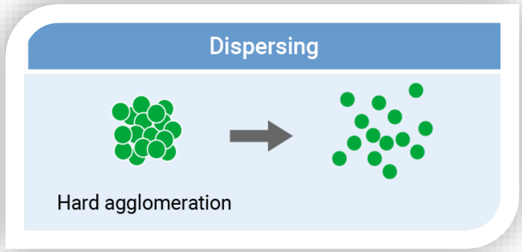
PAINT PRODUCTION PROCESS

- The **pre-mixing process** is crucial for blending raw materials in the correct proportions to achieve a homogeneous base paint mixture.
- To optimize the process, it's essential to adjust the ratio of the mixing tank diameter to the blade diameter, the blade height from the tank bottom, and the mixing speed to achieve the desired tip speeds.
- Once a homogeneous mixture is obtained, the **grinding process** is carried out until the desired fineness (micron level) is achieved.



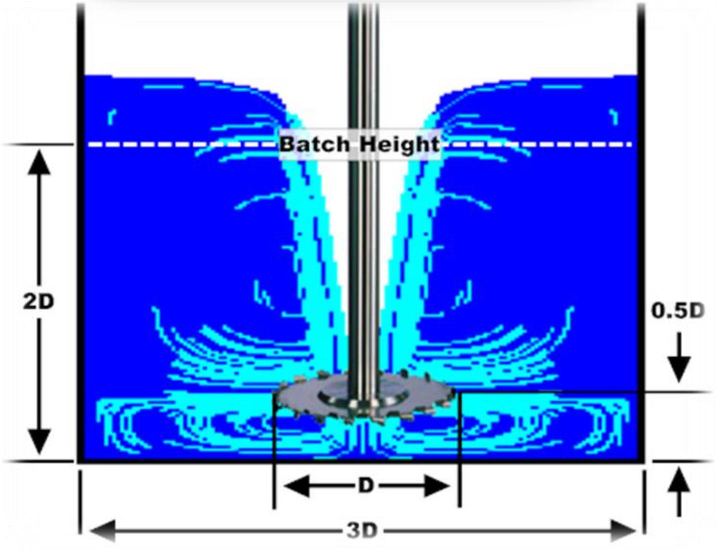


Figure 2. *Disperser Geometry Considerations*

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BACKGROUND INFORMATION

- This study explores efforts to enhance time efficiency in the paint production process.
- Within this scope, key parameters affecting production time are evaluated using the **Six Sigma methodology**, and improvement strategies are investigated to optimize both time and energy consumption.

Figure 3. Example of Six Sigma pricing strategy.

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BACKGROUND INFORMATION

- The majority of the increasing **greenhouse gas emissions** over the years stem from the energy sector.
- This study helped optimize time and energy consumption, reduce solvent use, and lower the overall **carbon footprint** by minimizing chemical emissions.

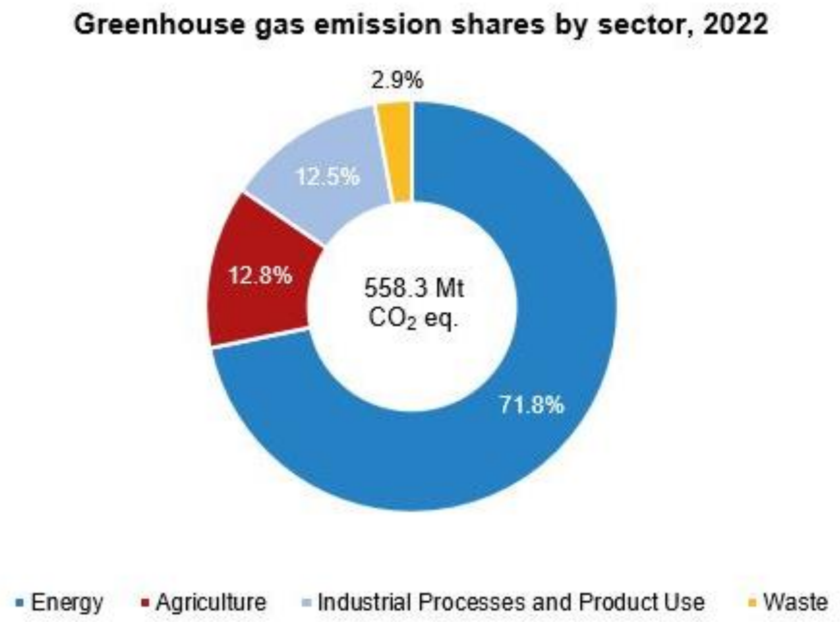


Figure 4. Greenhouse gas emissions by sector.

Figure 5. 11 ways how to reduce my carbon footprint

MOTIVATION

- Controlled experiments were conducted on high-viscosity filled barite pigment and low-viscosity organic blue pigment products.
- Selected due to the need for multiple grinding passes to achieve target size.
- Extended grinding times caused delivery delays. This study showed that improving **grinding performance** resulted in significant savings in both time and energy.

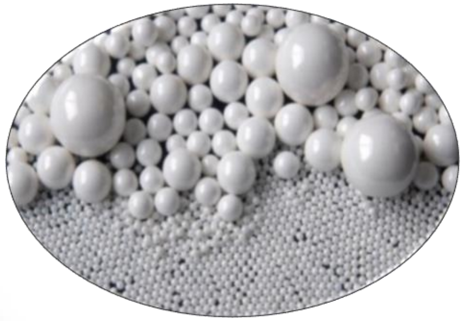
Figure 6. Illustration of the concept of viscosity.

MOTIVATION

- Parameters such as paint quantity, pre-mixing process and duration, mixer type, grinding machine, micron size obtained from pre-mixing, input viscosities, and input temperatures were kept constant.
- <u>Only the key factors affecting the grinding process were varied.</u>

  The key factors influencing the grinding process include;

  - Grinding Machine Speed (rpm),
  - Pump Pressure (bar),
  - Grinding Bead Sizes (mm).



EXPERIMENTS AND RESULTS

Table 1. Effects of Grinding Process Factors on Filled Barite Pigment

Trial	Input Viscosity	Pre-Mixing Fineness (μ)	Pre-Mixing Duration (min)	Bead Size (mm)	Mill Speed (rpm)	Pump Pressure (bar)	Flow Rate (1 min-Gram)	Total Time (sec)	Total Grinding Passes
1	43±2 °C 95±2 KU	45	25	0.9-1.1 mm	1500	2	662	1405	6
2	43±2 °C 95±2 KU	45	25	0.9-1.1 mm	1800	2	1000	1410	4
3	43±2 °C 95±2 KU	45	25	0.9-1.1 mm	1500	3	1647	1245	9
4	43±2 °C 95±2 KU	45	25	0.9-1.1 mm	1800	3	3018	1050	6
5	43±2 °C 95±2 KU	45	25	1.9-2.1 mm	1500	2	1536	1040	8
6	43±2 °C 95±2 KU	45	25	1.9-2.1 mm	1800	2	654	1577	6
7	43±2 °C 95±2 KU	45	25	1.9-2.1 mm	1500	3	2120	850	9
8	43±2 °C 95±2 KU	45	25	1.9-2.1 mm	1800	3	2070	835	8

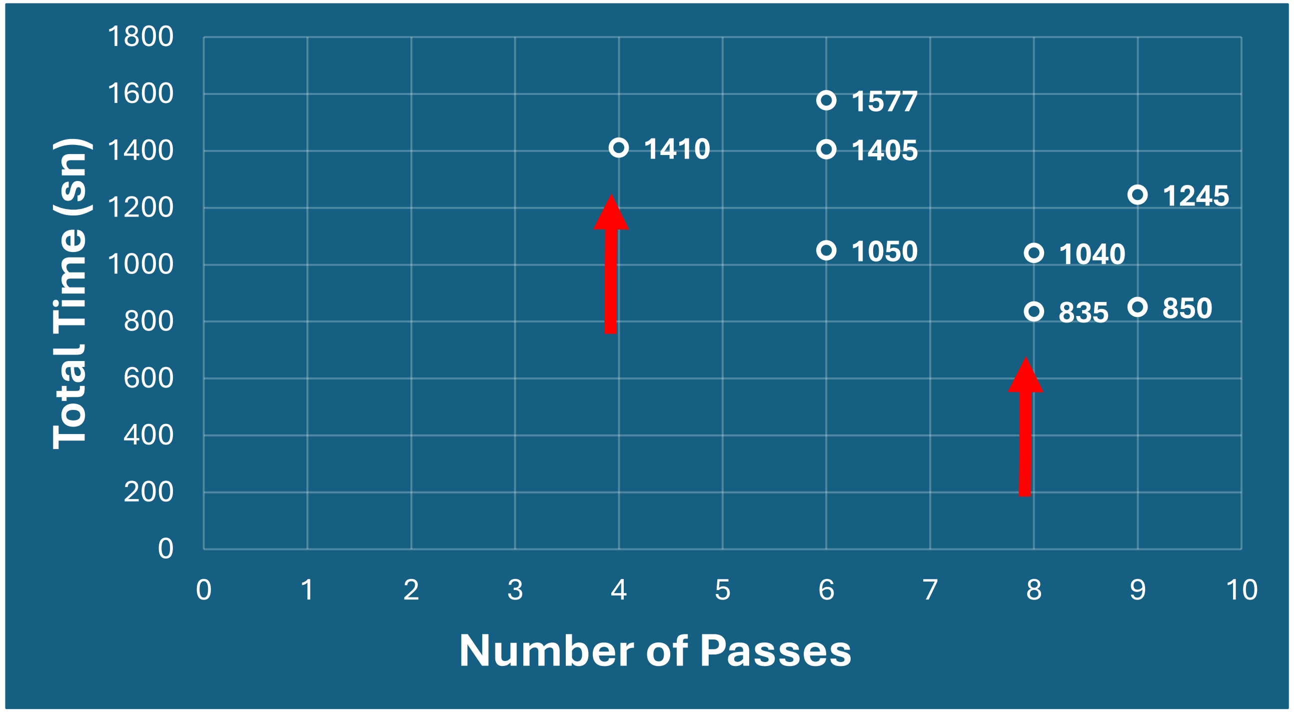
1) HIGH-VISCOSITY FILLED BARITE PIGMENT

To achieve optimal grinding performance for this product, it is essential to use **2 mm beads, high mill speed**, and **high pump pressure.**

EXPERIMENTS AND RESULTS

- Relationship Between Number of Passes and Total Time

Table 4. Relationship Between Number of Passes and Total Time



THE INCREASE IN THE NUMBER OF PASSES CANNOT BE RELATED TO THE TOTAL DURATION.

EXPERIMENTS AND RESULTS

Table 2. The Effect of Grinding Process Factors on Flow Rate

Trial	Input Viscosity	Pre-Mixing Fineness (µ)	Pre-Mixing Duration (min)	Bead Size (mm)	Mill Speed (rpm)	Pump Pressure (bar)	Flow Rate (1 min-Gram)	Total Time (sec)	Total Grinding Passes
1	43±2 °C 95±2 KU	45	25	0.9-1.1 mm	1500	2	662	1405	6
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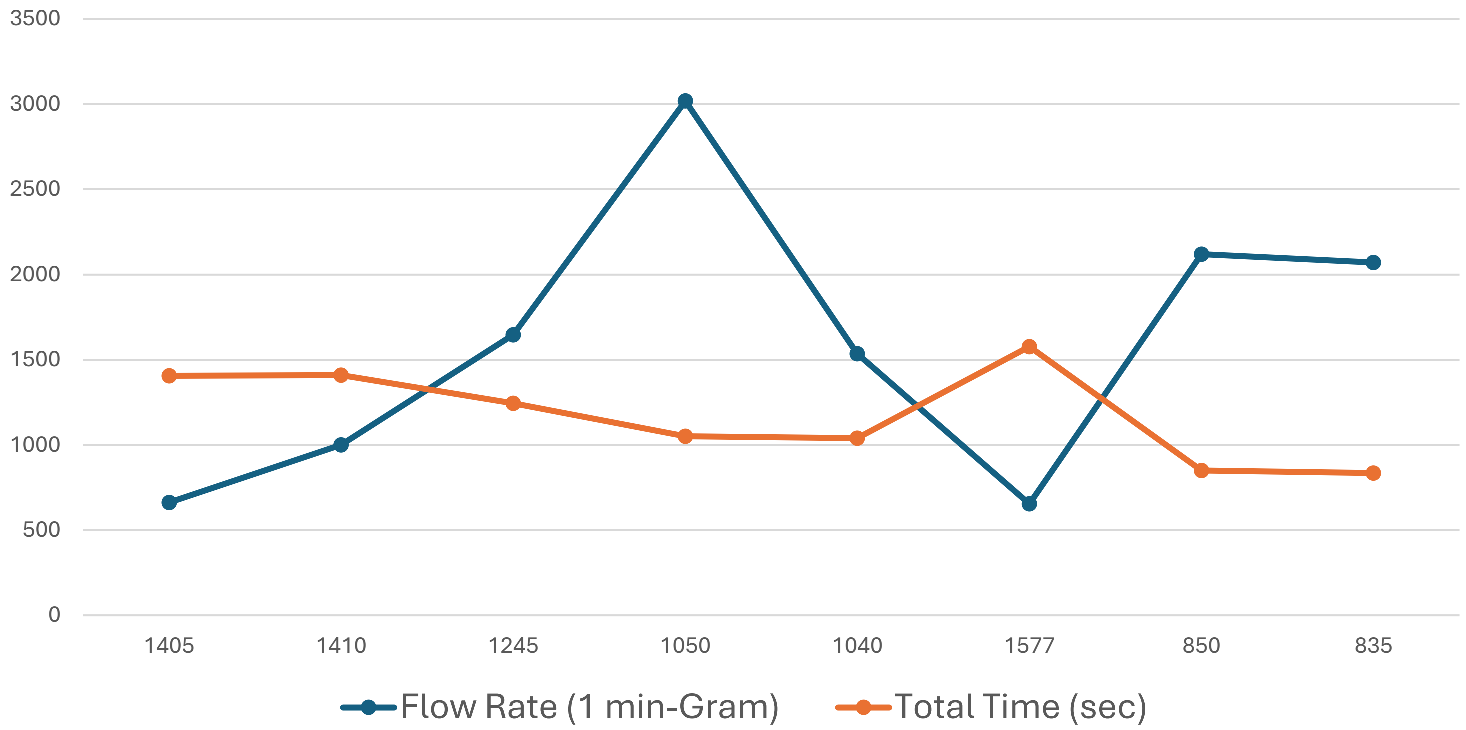
6	43±2 °C 95±2 KU	45	25	1.9-2.1 mm	1800	2	654	1577	6
7	43±2 °C 95±2 KU	45	25	1.9-2.1 mm	1500	3	2120	850	9
8	43±2 °C 95±2 KU	45	25	1.9-2.1 mm	1800	3	2070	835	8

FLOW RATE

- Flow rate is related to machine speed, pump pressure, and bead size.

EXPERIMENTS AND RESULTS

Table 3. The Effect of Grinding Process Factors on Flow Rate



FLOW RATE

- When all parameters are properly selected, the flow rate reaches an optimal level.
- However, a high flow rate does not necessarily indicate that the process is being applied correctly.

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EXPERIMENTS AND RESULTS

Table 6. Effects of Grinding Process Parameters on Filled Barite Pigment in the Production Process

Trial	Input Viscosity	Pre-Mixing Fineness (μ)	Pre-Mixing Duration (min)	Bead Size (mm)	Mill Speed (rpm)	Pump Pressure (bar)	Flow Rate (1 min-Gram)	Total Time (min)	Total Grinding Passes
1	55-60°C 95±2 KU	45	90	0.9-1.1 mm	600	1	9045	368	3
2	55-60°C 95±2 KU	45	90	0.9-1.1 mm	800	1	13665	370	2
3	55-60°C 95±2 KU	45	90	0.9-1.1 mm	600	2	22510	326	5
4	55-60°C 95±2 KU	45	90	0.9-1.1 mm	800	2	41245	275	3
5	55-60°C 95±2 KU	45	90	1.9-2.1 mm	600	1	20990	272	4
6	55-60°C 95±2 KU	45	90	1.9-2.1 mm	800	1	8940	413	3
7	55-60°C 95±2 KU	45	90	1.9-2.1 mm	600	2	28970	223	5
8	55-60°C 95±2 KU	45	90	1.9-2.1 mm	800	2	28290	219	4

The trials were performed in-line during the production process to ensure process compatibility and performance evaluation.

EXPERIMENTS AND RESULTS

Table 7. Effects of Grinding Process Factors on Organic Blue Pigment

Trial	Input Viscosity	Pre-Mixing Fineness (µ)	Pre-Mixing Duration (min)	Bead Size (mm)	Mill Speed (rpm)	Pump Pressure (bar)	Flow Rate (1 min-Gram)	Total Time (sec)	Total Grinding Passes
1	30±2°C 68±2 KU	µ > 100	18	0.9-1.1 mm	1500	2	960	1735	10
2	30±2°C 68±2 KU	µ > 100	18	0.9-1.1 mm	1800	2	735	1755	9
3	30±2°C 68±2 KU	µ > 100	18	0.9-1.1 mm	1500	3	1465	1010	12
4	30±2°C 68±2 KU	µ > 100	18	0.9-1.1 mm	1800	3	2420	740	11
5	30±2°C 68±2 KU	µ > 100	18	1.9-2.1 mm	1500	2	1380	2825	19
6	30±2°C 68±2 KU	µ > 100	18	1.9-2.1 mm	1800	2	1280	2965	21
7	30±2°C 68±2 KU	µ > 100	18	1.9-2.1 mm	1500	3	2280	1850	22
8	30±2°C 68±2 KU	µ > 100	18	1.9-2.1 mm	1800	3	2350	1820	25

2) LOW-VISCOSITY ORGANIC BLUE PIGMENT

To achieve optimal grinding performance for this product, it is essential to use **1 mm beads, high mill speed**, and **high pump pressure.**

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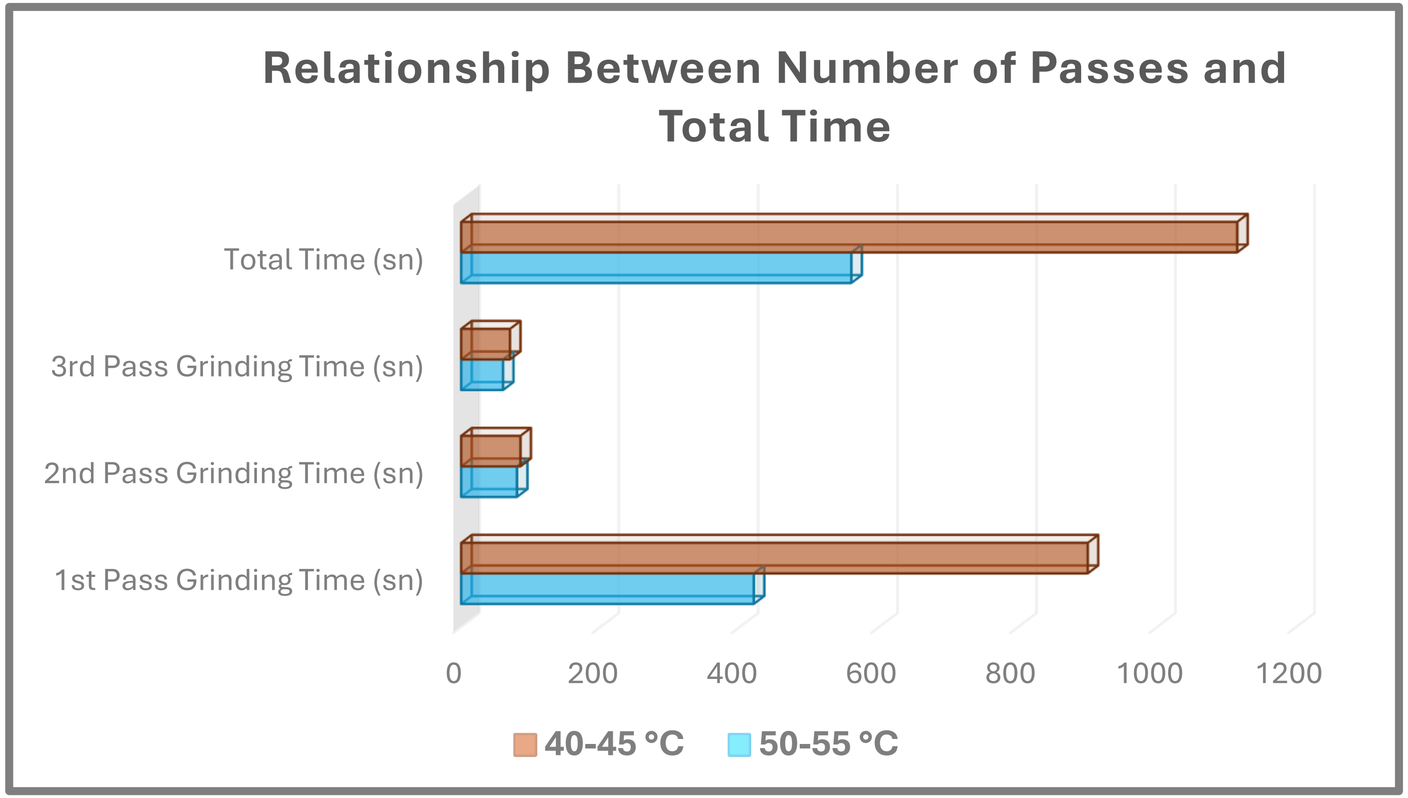
EXPERIMENTS AND RESULTS

Table 5. Relationship Between Number of Passes and Total Time



- The **input temperature** has a significant impact on both the 1st pass duration and the total processing time.

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Table 8. Effects of Input Viscosity and Pre-Mixing Process on Total Time in the Production Process

Trial	Product Quantity (kg)	Input Viscosity	Pre-Mixing Fineness (µ)	Pre-Mixing Duration (min)	Bead Size (mm)	Mill Speed (rpm)	Pump Pressure (bar)	Flow Rate (1 min-Gram)	Total Time (sec)	Total Grinding Passes
1	1200	**55 °C 90 KU**	**45**	60	1.9-2.1 mm	800	3	28550	**90**	3
2	1200	**40 °C 116 KU**	**45**	60	1.9-2.1 mm	800	3	28290	**195**	3
3	1200	**45 °C 100 KU**	**55**	60	1.9-2.1 mm	800	3	27480	**265**	3

❖ These trials were carried out during the <u>production process</u>.

1) Immediately taken to milling after pre-mixing.
2) Taken to milling after pre-mixing and resting for one day.
3) Pre-mixing was done with a high micron level.

- If the pre-mixing process is not done correctly or
- If the initial viscosity is high, the total processing time increases.

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CONCLUSION

➢ The pre-mixing process must be carried out properly.

➢ Bead size, mill speed, and pump pressure should be selected according to the product's characteristics.

- high-viscosity filled barite pigment: 2 mm beads, high mill speed, and high pump pressure.
- low-viscosity organic blue pigment: 1 mm beads, high mill speed, and high pump pressure.

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CONCLUSION

- The increase in the number of passes cannot be correlated with the total time.
- Flow rate is influenced by machine speed, pump pressure, and bead size. When optimized, it reaches an ideal level.
- A high input temperature reduces the total time.
  - high-viscosity filled barite pigment: 50-55°C
  - low-viscosity organic blue pigment: 30-35°C
- As the input viscosity increases, the total time also increases.

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THANKS FOR ATTENTION!

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