

AN OPTIMIZATION OF SPANGLE MINIMIZER FOR AI-Si COATED STEEL SPANGLE CONTROL

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Introduction

► Spangle size needs to be small to improve surface quality.

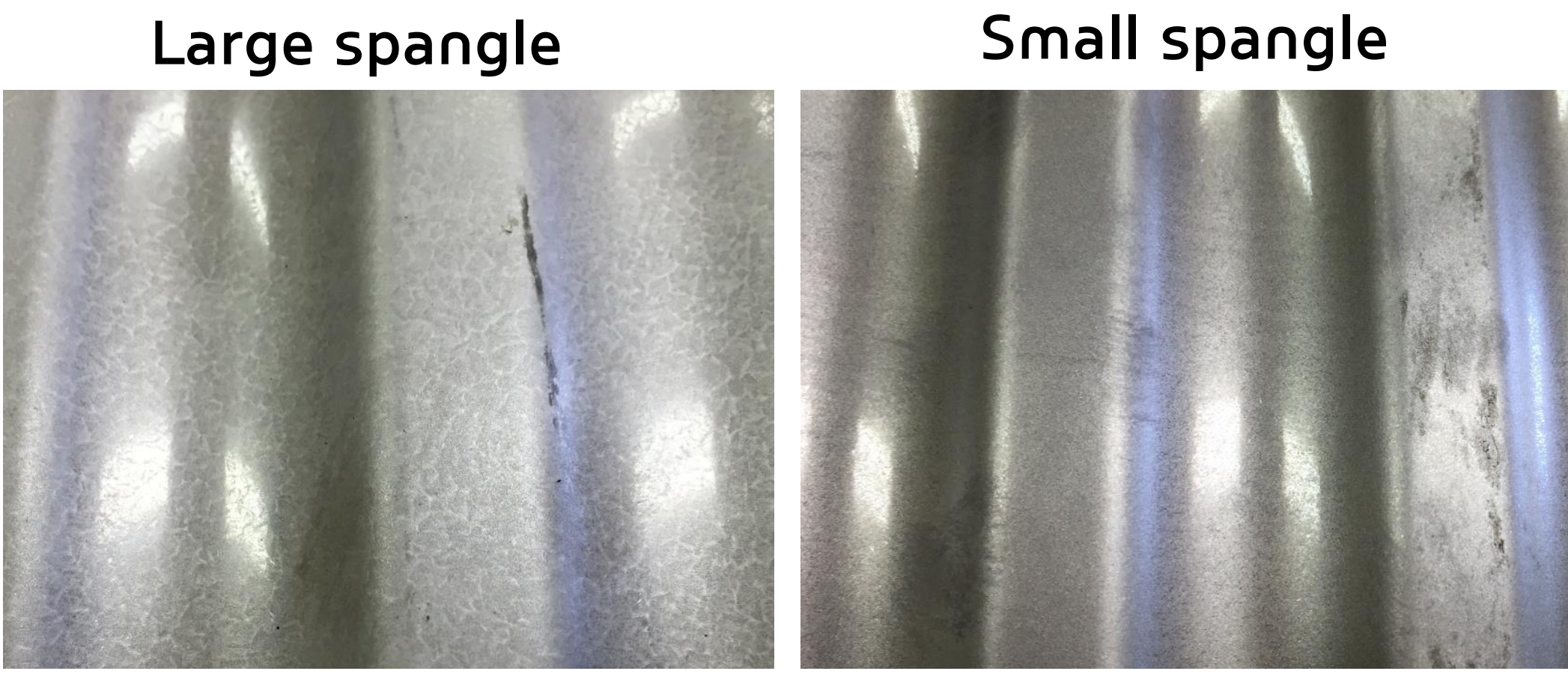


Fig. 1. Comparison of surface quality according to spangle size after pressing

► Spangle size can be controlled using Al powder.

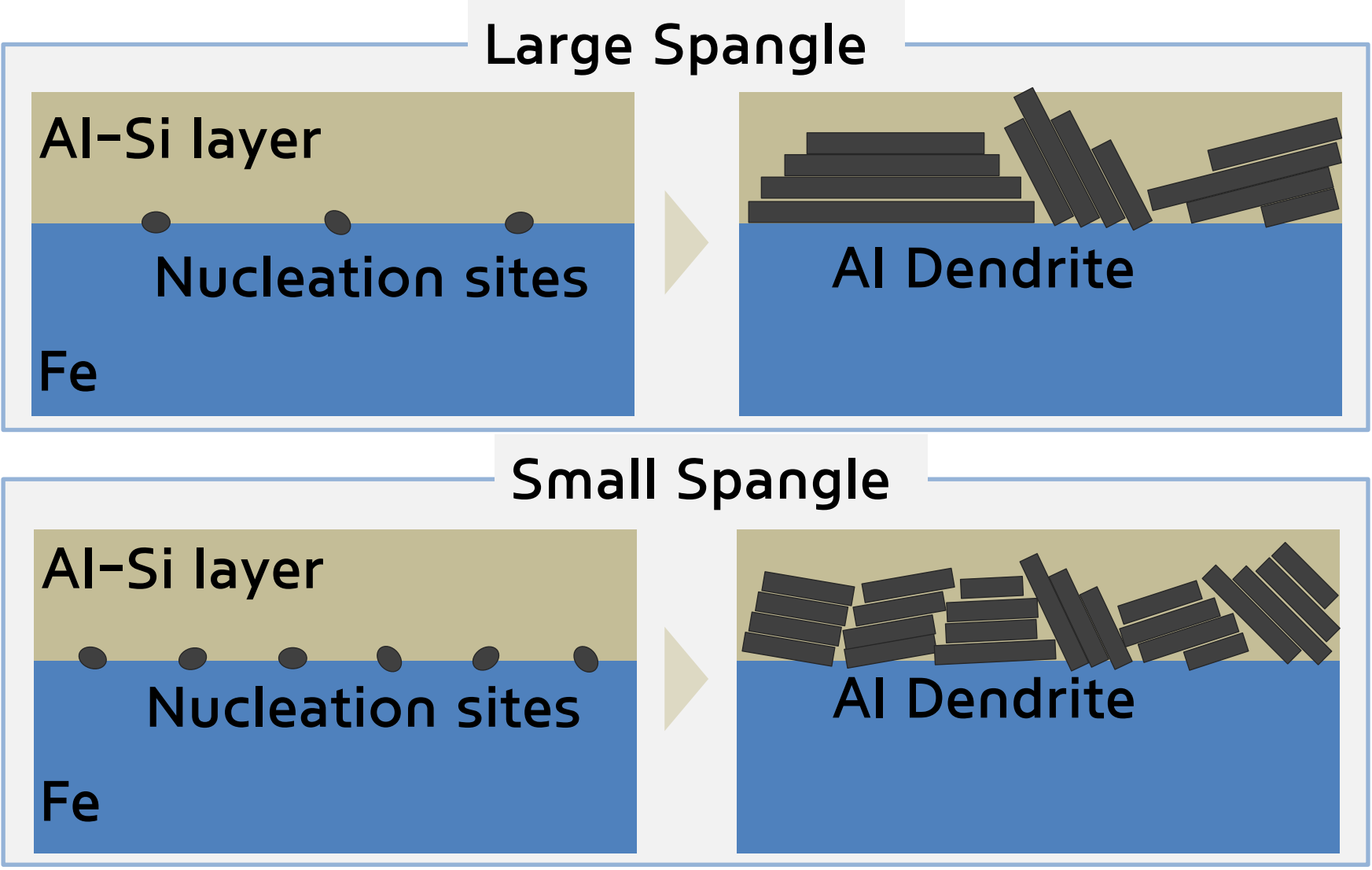


Fig. 2. the effect of nucleation sites on the formation of spangles

► Al powder can be supplied to the surface through the following spangle minimizer.

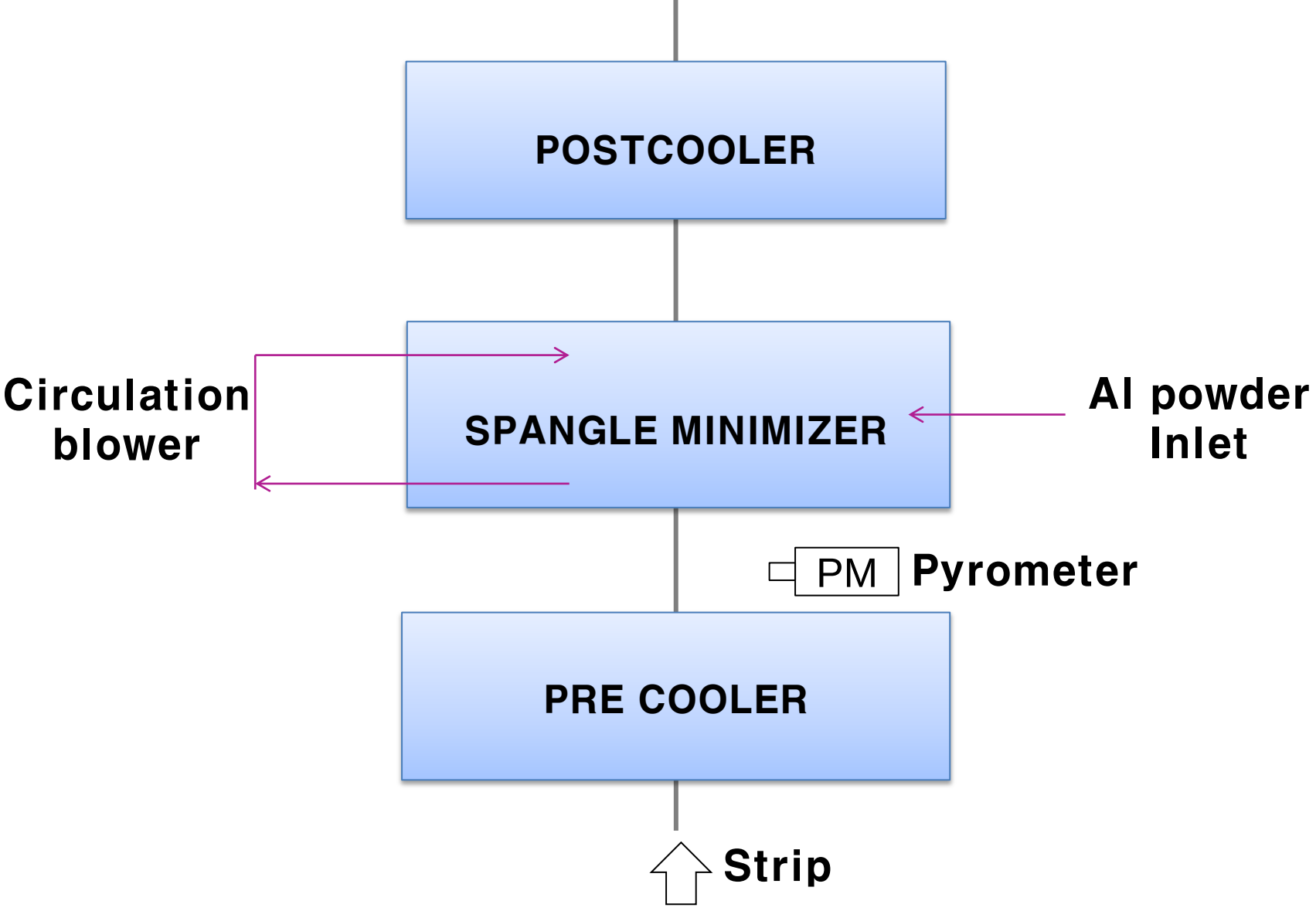


Fig. 3. Schematic diagram of spangle minimizer

Experiment

► Test was conducted by changing the production conditions of the spangle minimizer under different thicknesses.

Test No.		Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Test 10	Test 11	Test 12	Test 13	Test 14	Test 15	Test 16	Test 17	Test 18	Test 19	Test 20
Thickness/ Line speed		1.2mm/120mpm														1.0mm/150mpm					
Precooler Height(m)		5.2	5.2	6.6	6.6	6.6	5.2	6.2	6.2	6.2	6.2	6.2	6.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2
Spangle Minimizer	Inlet Temp(°C)	560	565	565	570	570	565	570	570	570	570	570	570	570	570	570	570	570	580	570	570
	Al powder inlet Motor Power(%)	5	10	10	10	10	5	5	15	25	35	15	15	15	15	15	20	20	15	15	15
	Circulation Motor Power(%)	65	65	65	65	65	65	65	65	65	65	50	75	75	75	90	75	90	75	75	75
Postcooler Motor power(%)		25	25	25	25	50	25	42	42	42	42	42	42	42	55	42	42	42	42	25	42

Table 1. Spangle minimizer production conditions by test

Results and discussion

► By comparing the results of each test, the effect of each parameter on the spangle size can be compared

(Unit: mm)

Test 1: 0.5	Test 2: 0.53	Test 3: 0.6	Test 4: 0.56	Test 5: 0.64	Test 6: 0.6	Test 7: 1.12	Test 8: 0.75	Test 9: 0.82	Test 10: 0.65
Test 11: 0.9	Test 12: 0.6	Test 13: 0.45	Test 14: 0.64	Test 15: 0.3	Test 16: 0.56	Test 17: 0.31	Test 18: 0.64	Test 19: 0.69	Test 20: 0.64

Table 2. Spangle size comparison for each test

- Precooler Height: not significantly affected (By comparing Test 2,3 and Test 12,13 respectively)
- Inlet Temperature: not significantly affected (By comparing Test 1,6 and Test 3,4 and Test 18,20 respectively)
 - Not significantly affected, which seems to be because the experimental temperature range was before the solidification process.
- Al powder inlet motor power: Spangle gets smaller as inlet motor power increases(By comparing Test 7,8,9,10)
- Circulation Motor Power: gets smaller as inlet motor power increases (By comparing Test 11,12 and Test 16,17 and Test 15 20 respectively)
 - The amount of aluminum powder should increase as the production speed increases, but at the same time, it is necessary to increase the load of an appropriate circulation motor.
- Post cooler: not significantly affected (By comparing Test 4,5 and Test 13,14 and Test 19,20 respectively)
 - After spangle nucleation is generated by Al powder, The effect of postcooler seems to be insignificant.

Conclusions

- By adjusting the parameters of the spangle minimizer, you can optimize the production conditions.
- Some factors appeared to have little effect on the spangle size, but it is expected that different results may be produced if conditions such as steel grade or pot temperature or Pot inlet strip temperature are changed.