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Aplicação de coating para redução da degradação intemperica e controle de emissão de particulados de aglomerados de minério de ferro

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APPLICATION OF COATING TO REDUCE WEATHER DEGRADATION AND CONTROL EMISSIONS OF PARTICULATES FROM IRON ORE AGGLOMERATES

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Introduction

- ✓ Iron ore agglomerates are generally stored in open-air yards = Exposure to adverse weather conditions = Aging phenomenon.
- ✓ Aging phenomenon: Degradation of mechanical properties due to exposure to climatic differences during the storage period.
- ✓ Handling, transportation and storage stresses + climatic differences = emission of particulates.

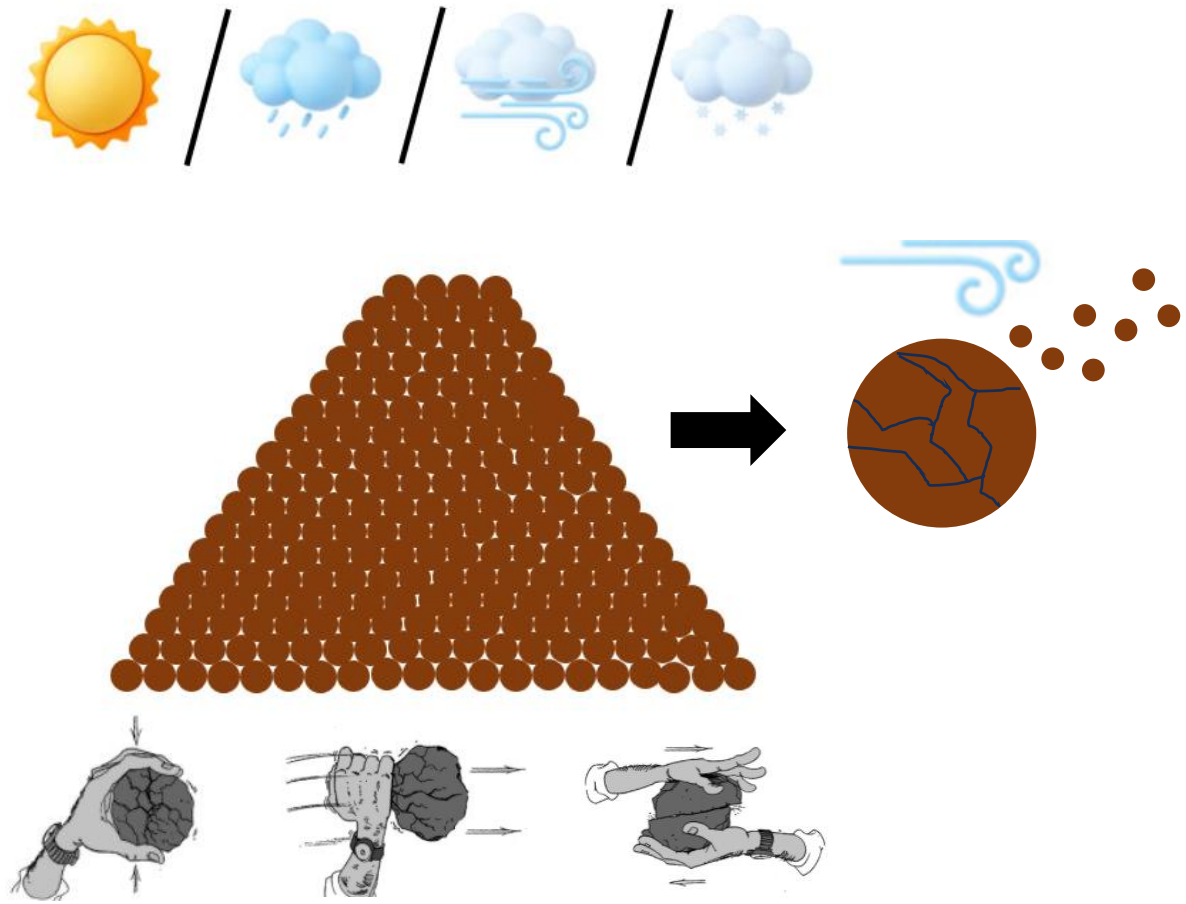

Figure 1. Aging phenomenon of iron ore agglomerates

Dust supressants agents

Main mechanisms of action:

- ✓ Wettings
- ✓ Binders
- ✓ Surfactants

Conversion of small particles into agglomerates of greater mass and diameter

- ✓ Film formers

Formation of a film with certain strength on the surface of dust trapping it and preventing its diffusion by airflow disturbance

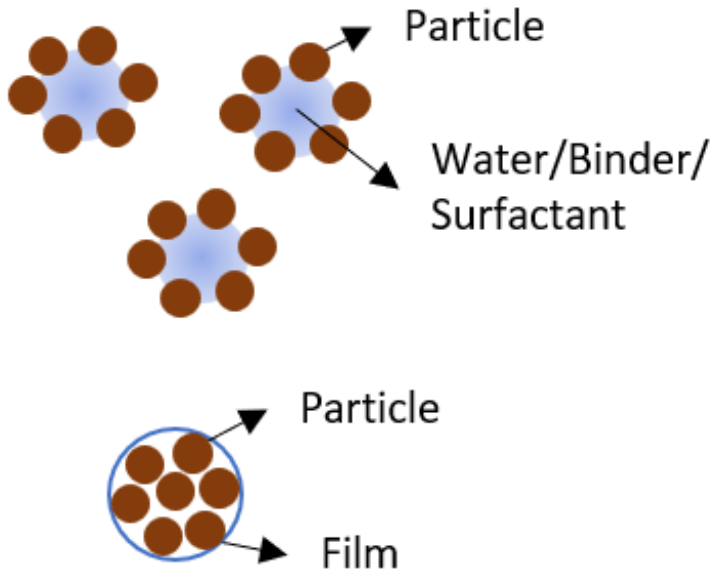

Figure 2. Mechanisms of action of dust suppressants

Introduction

Waterproofing agents

Main mechanisms of action:

- ✓ Hydrophobic agents → Formation of hydrophobic film on the surface of particles
- ✓ Crystalline admixtures → Formation of crystalline compounds inside the pores

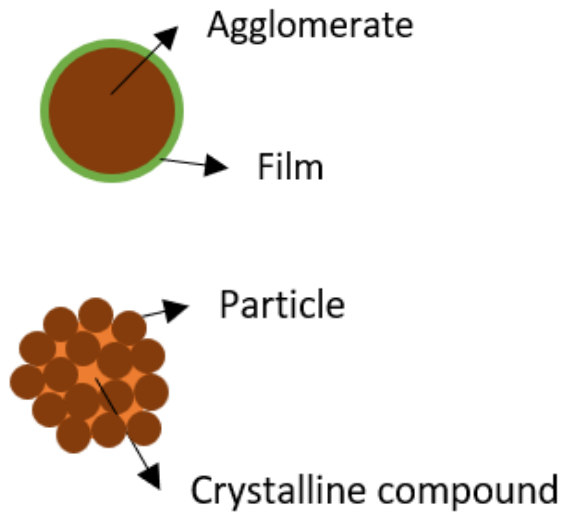

Figure 3. Mechanisms of action of waterproofing agents

Metodology

Product selection:

- ✓ 57 products;
- ✓ Bibliographic review;
- ✓ Availability;
- ✓ Dual function.

Table 1. Products tested according to their mechanism of action

Wettings	Binders	Surfactants	Film formers
P9, P17 e P22	P7, P8, P11, P13, P14, P15, P19, P21, P23, P25, P26, P27, P28, P30, P31, P32, P33, P34, P36, P37, P38 e P48	P10, P18, P20, P24, P44, P53 e P54	P1, P2, P3, P4, P5, P6, P12, P16, P29, P35, P39, P40, P41, P42, P43, P45, P46, P47, P49, P50, P51, P52, P55, P56 e P57

Application method:

- ✓ Spraying

Characterization methods:

- ✓ Static waterproof
- ✓ Compressive strength (before and after waterproof)
- ✓ Tumbler (before and after waterproof)

- ✓ Note: Due to limited availability, two different batches of agglomerates were used.

Results and discussion – Compressive strength

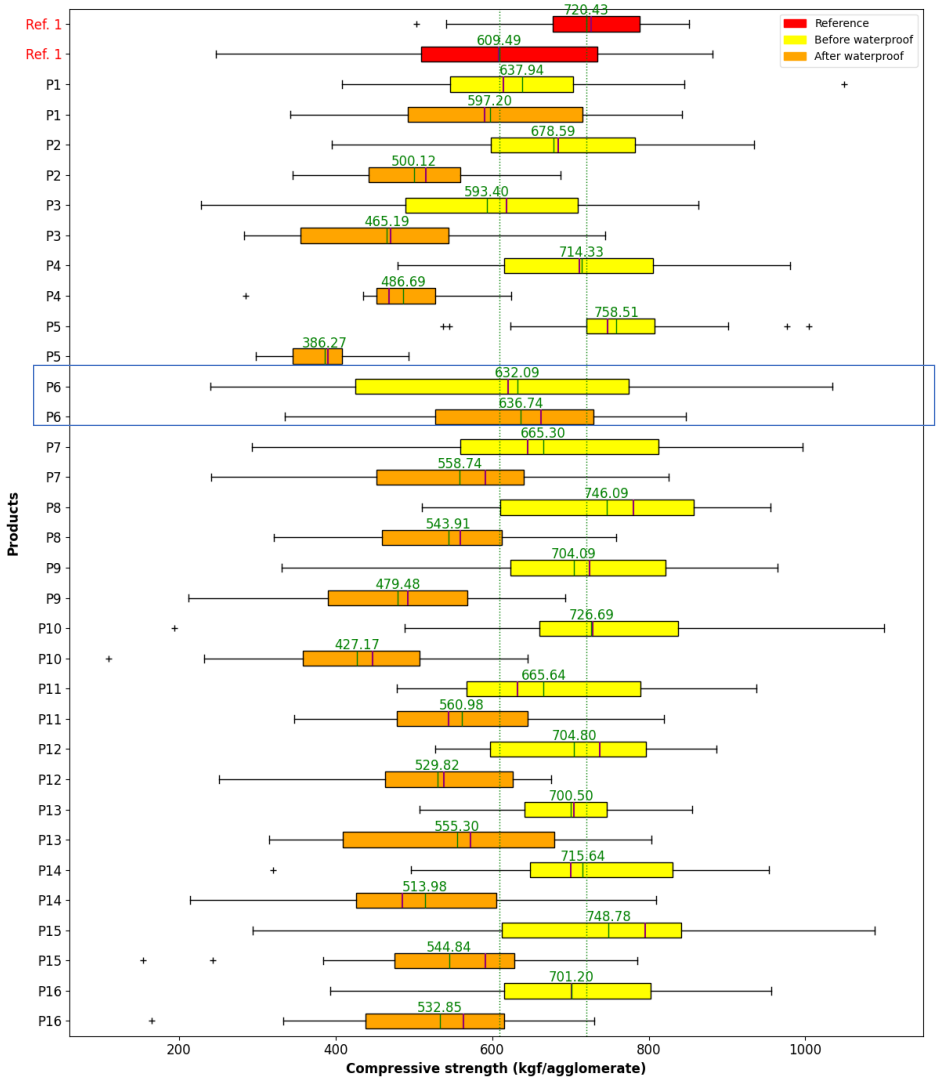

Figure 4. Compressive strength of coated agglomerates from batch 1 (Part 1)

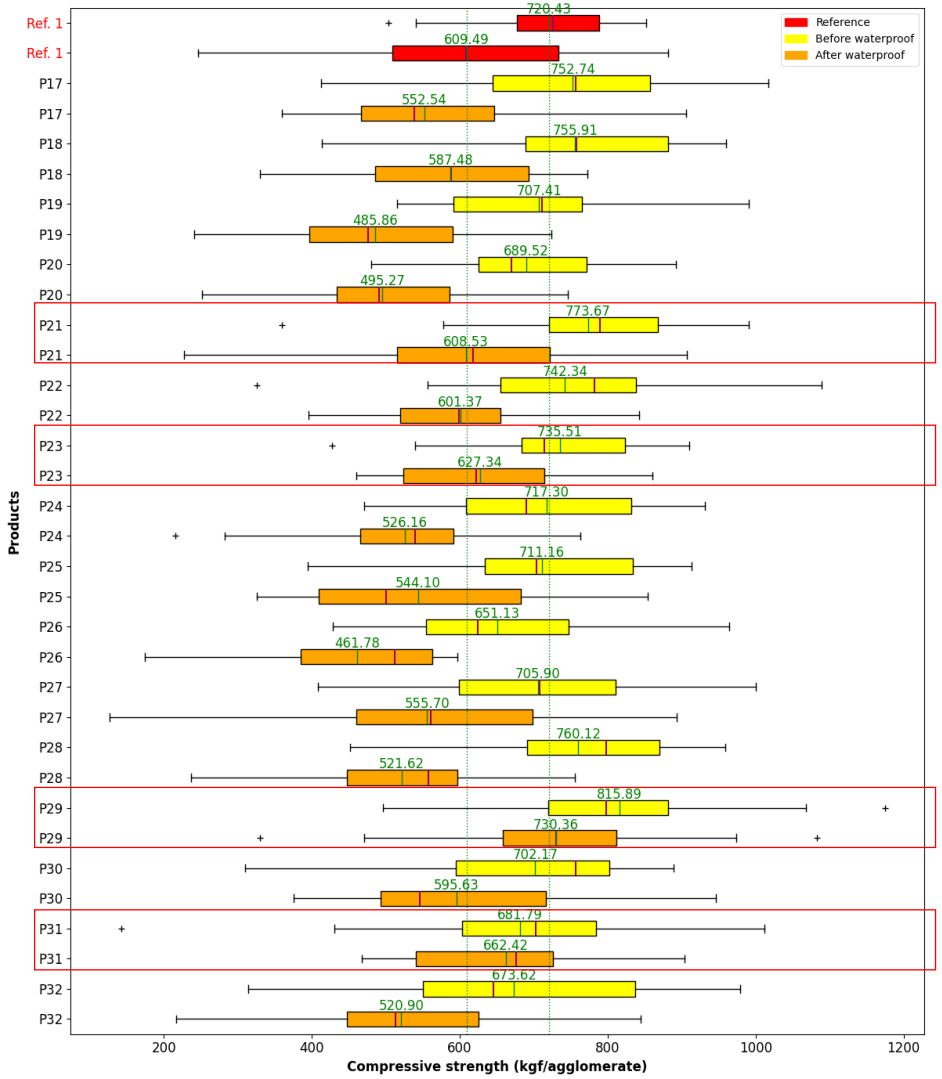

Figure 5. Compressive strength of coated agglomerates from batch 1 (Part 2)

Results and discussion – Compressive strength

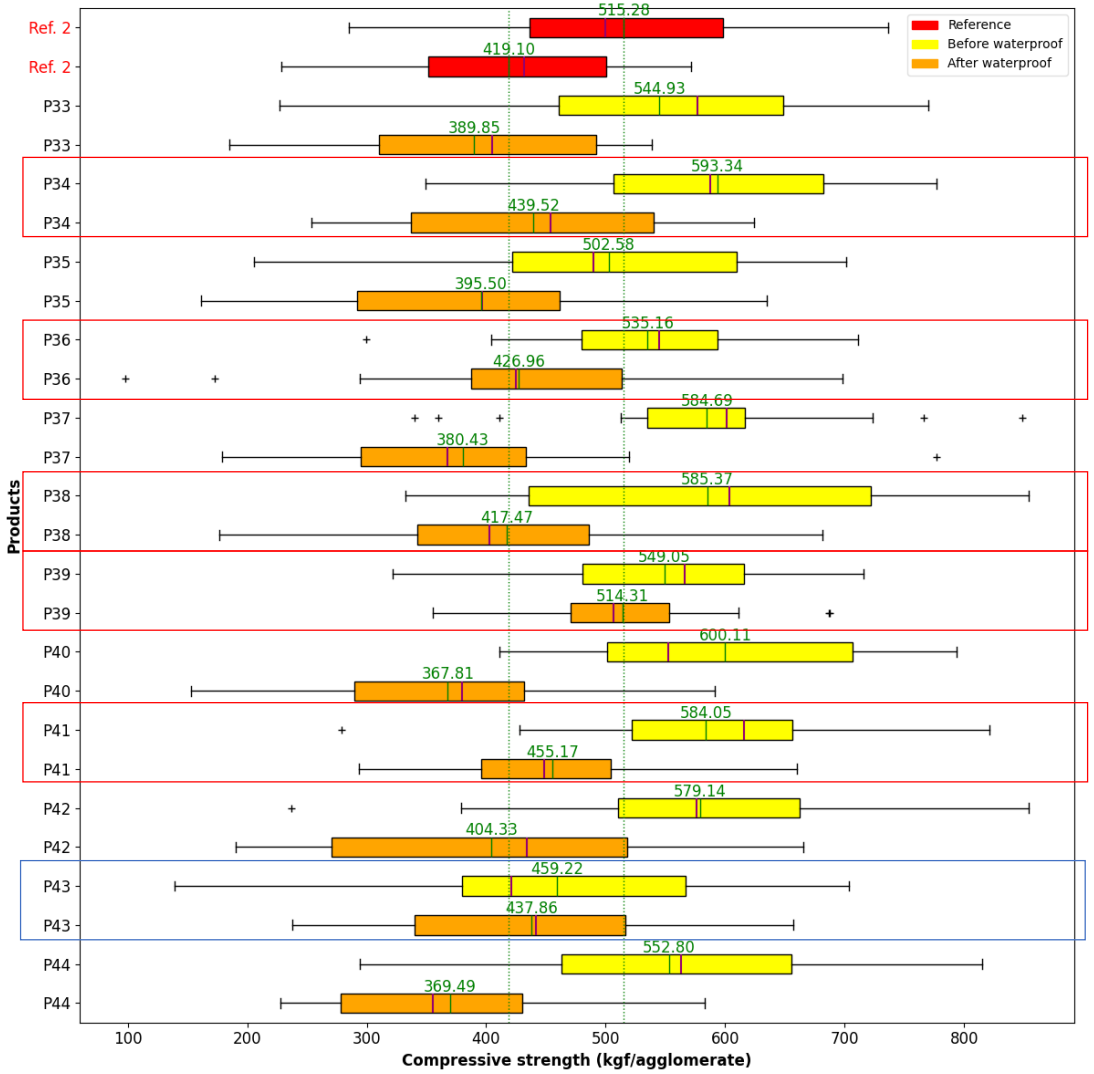

Figure 6. Compressive strength of coated agglomerates from batch 2 (Part 1)

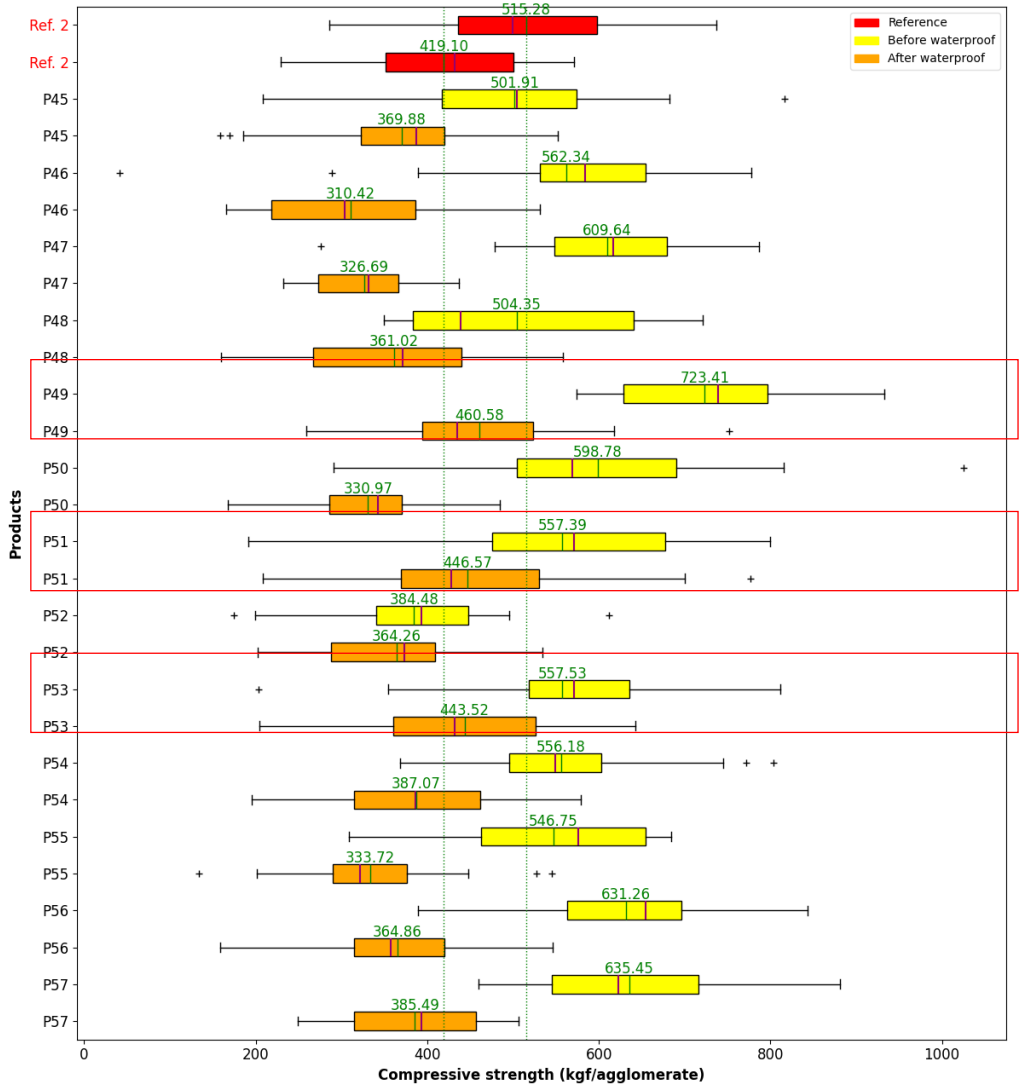

Figure 7. Compressive strength of coated agglomerates from batch 2 (Part 2)

Results and discussion – Tumbler index

Table 2. Tumbler index of coated agglomerates from batch 1

Product	Before waterproof	After waterproof	Product	Before waterproof	After waterproof	Product	Before waterproof	After waterproof
Ref. 1	92,74%	91,26%	P11	91,99%	92,31%	P22	96,73%	92,32%
P1	95,67%	94,72%	P12	94,32%	94,99%	P23	95,89%	92,67%
P2	95,81%	96,31%	P13	93,73%	93,84%	P24	97,94%	94,59%
P3	92,49%	90,36%	P14	94,00%	90,76%	P25	95,47%	90,71%
P4	93,12%	90,69%	P15	93,30%	91,38%	P26	92,51%	90,68%
P5	98,24%	95,83%	P16	93,72%	94,35%	P27	95,25%	91,42%
P6	98,47%	96,68%	P17	94,57%	92,34%	P28	96,55%	90,48%
P7	93,27%	93,16%	P18	95,27%	95,81%	P29	98,06%	96,99%
P8	94,72%	93,60%	P19	96,58%	92,30%	P30	92,82%	94,69%
P9	98,68%	96,18%	P20	94,72%	93,60%	P31	96,24%	91,04%
P10	95,92%	95,06%	P21	97,71%	94,19%	P32	95,59%	92,71%

Table 3. Tumbler index of coated agglomerates from batch 2

Product	Before waterproof	After waterproof	Product	Before waterproof	After waterproof	Product	Before waterproof	After waterproof
Ref. 2	89,25%	89,12%	P41	96,08%	95,01%	P50	98,75%	97,21%
P33	94,09%	89,75%	P42	95,75%	93,72%	P51	90,86%	89,27%
P34	97,18%	90,10%	P43	93,48%	89,48%	P52	98,03%	92,72%
P35	95,48%	91,66%	P44	93,23%	91,64%	P53	95,83%	87,91%
P36	95,08%	87,23%	P45	94,43%	86,24%	P54	89,40%	90,07%
P37	94,78%	87,14%	P46	96,46%	92,00%	P55	93,20%	92,84%
P38	91,93%	88,08%	P47	94,96%	92,83%	P56	95,14%	92,04%
P39	95,12%	94,68%	P48	93,42%	86,89%	P57	92,80%	91,59%
P40	97,87%	93,33%	P49	99,56%	99,77%			

Results and discussion – Abrasion index

Tabela 4. Abrasion index of coated agglomerates from batch 1

Product	Before waterproof	After waterproof	Product	Before waterproof	After waterproof	Product	Before waterproof	After waterproof
Ref. 1	7,35%	8,87%	P11	8,16%	7,96%	P22	4,09%	7,72%
P1	4,55%	5,44%	P12	5,92%	5,26%	P23	4,19%	7,48%
P2	4,42%	3,88%	P13	6,40%	6,44%	P24	2,23%	5,47%
P3	7,72%	9,78%	P14	6,16%	9,30%	P25	4,63%	9,54%
P4	7,27%	9,63%	P15	6,93%	8,69%	P26	7,74%	9,75%
P5	2,04%	5,25%	P16	6,51%	5,72%	P27	4,97%	8,87%
P6	2,18%	4,53%	P17	5,51%	7,79%	P28	3,90%	9,64%
P7	6,85%	6,91%	P18	5,04%	4,50%	P29	2,27%	4,78%
P8	5,48%	6,52%	P19	3,55%	7,85%	P30	7,36%	5,41%
P9	1,50%	4,14%	P20	1,84%	6,88%	P31	3,96%	9,38%
P10	7,32%	8,59%	P21	2,50%	5,86%	P32	4,57%	7,51%

Tabela 5. Abrasion index of coated agglomerates from batch 2

Product	Before waterproof	After waterproof	Product	Before waterproof	After waterproof	Product	Before waterproof	After waterproof
Ref. 2	10,90%	11,09%	P41	4,13%	5,26%	P50	1,32%	3,07%
P33	6,28%	10,34%	P42	4,47%	6,80%	P51	9,25%	10,84%
P34	3,01%	10,21%	P43	6,79%	10,87%	P52	2,24%	7,50%
P35	3,01%	10,21%	P44	6,87%	8,71%	P53	4,24%	12,20%
P36	5,03%	12,92%	P45	5,68%	14,02%	P54	11,11%	10,27%
P37	5,23%	13,06%	P46	3,77%	8,84%	P55	7,11%	7,51%
P38	8,15%	12,04%	P47	5,30%	7,68%	P56	5,26%	8,44%
P39	5,30%	5,77%	P48	6,81%	13,26%	P57	4,27%	5,18%
P40	2,21%	7,47%	P49	0,49%	0,24%			

Results and discussion – Fines reduction

Table 6. Reduction of fine fraction compared to references (after waterproof)

Product	Fines x Reference	Product	Fines x Reference	Product	Fines x Reference	Product	Fines x Reference
P49	98%	P47	31%	P34	8%	P36	-16%
P50	72%	P5	28%	P54	7%	P10	-17%
P57	53%	P12	28%	P33	7%	P37	-18%
P41	53%	P30	26%	P20	6%	P15	-18%
P39	48%	P1	26%	P7	6%	P48	-20%
P2	47%	P24	26%	P43	2%	P27	-21%
P9	44%	P56	24%	P23	-2%	P45	-26%
P18	39%	P16	22%	P32	-2%	P14	-27%
P42	39%	P44	21%	P22	-5%	P31	-28%
P6	38%	P46	20%	P17	-6%	P25	-30%
P29	35%	P21	20%	P19	-7%	P4	-31%
P40	33%	P13	12%	P11	-8%	P28	-31%
P52	32%	P8	11%	P38	-9%	P26	-33%
P55	32%	P35	8%	P53	-10%	P3	-33%

Results and discussion – Comparative panel

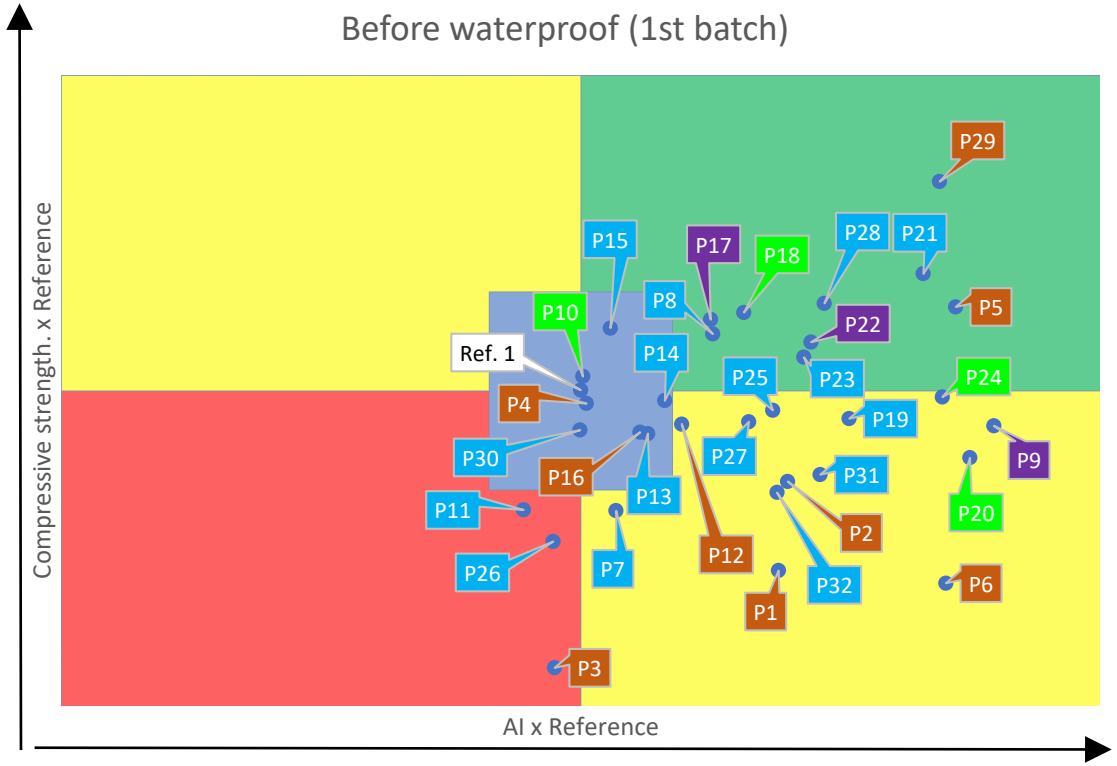

Figure 8. Comparative panel for agglomerates before the weathering test (batch 1)

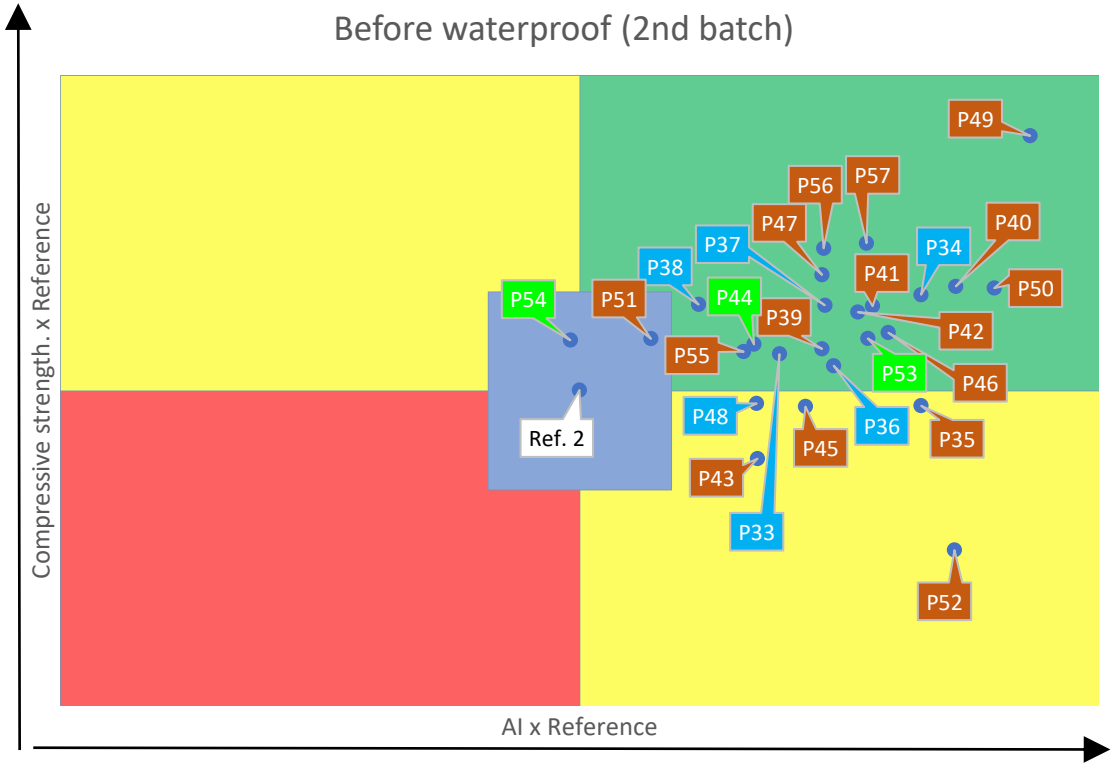

Figure 9. Comparative panel for agglomerates before the weathering test (batch 2)

Caption: Wettings Binders Surfactants Film formers

Results and discussion – Comparative panel

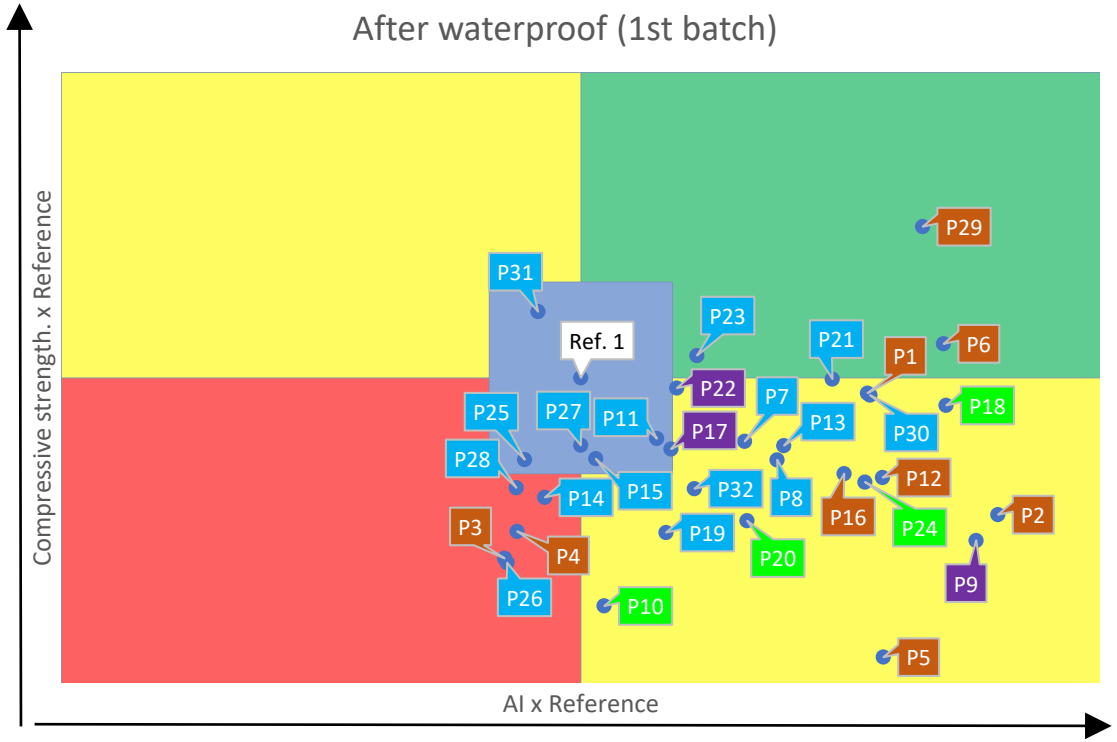

Figure 8. Comparative panel for agglomerates before the weathering test (batch 1)

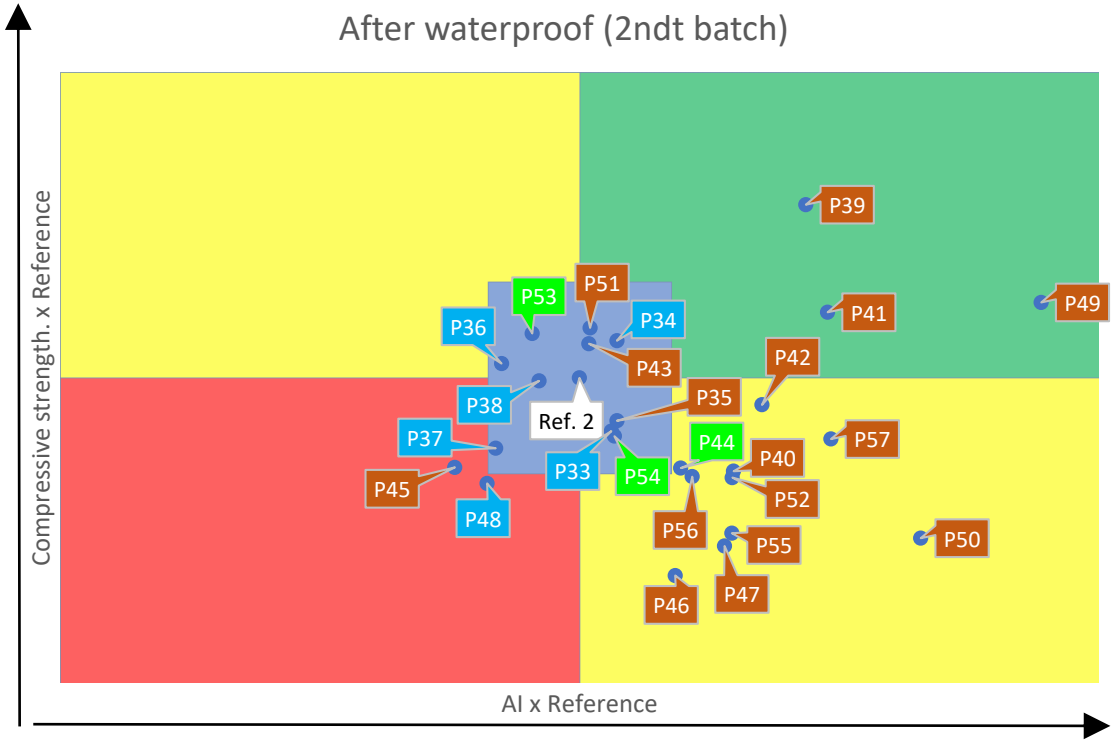

Figure 9. Comparative panel for agglomerates before the weathering test (batch 2)

Caption: Wettings Binders Surfactants Film formers

Conclusions

The results obtained allow the following conclusions:

- ✓ Coating iron ore agglomerates can help protect them from degradability and reduce dust emissions during handling and transportation;
- ✓ The best results were obtained for products **P6**, P21, P23, **P29**, P34, **P39**, **P41**, **P43**, **P49** and **P51**.
- ✓ Hydrophobic and membrane-forming additives have greater potential for applicability for the proposed objective;

Thank you!

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