

SE AISI STEEL MEGA EVENT & EXPO 2022 WASTE MANAGEMENT

100% By-Product Recycling in Krakatau Posco

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1. Overview

2. Legal Standing

3. By-Product Balance

4. Business Expansion

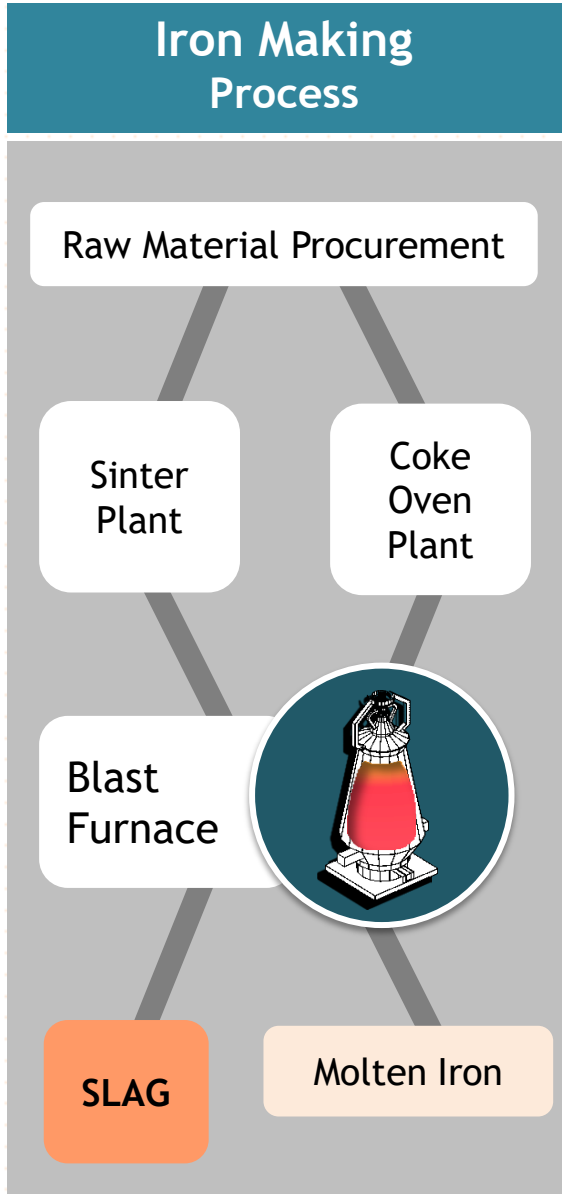
- Converting Method Landfill To Utilization
- Developing By-product Utilization With High Value Added

5. Conclusion



OVERVIEW - IRON AND STEEL MAKING PROCESS

Iron Making Process



Steel Making Process

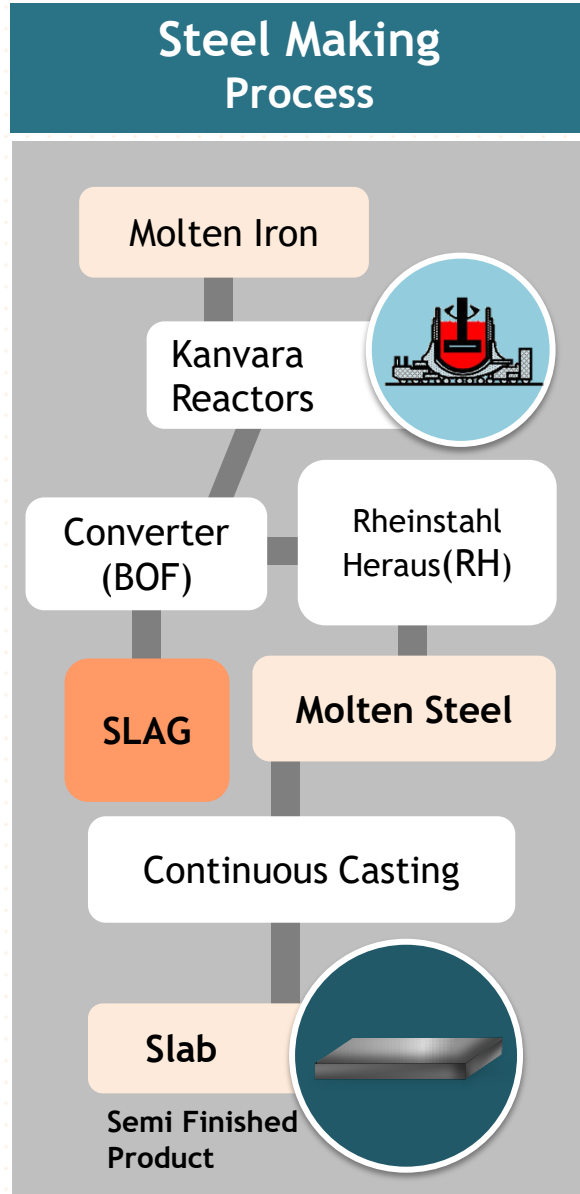
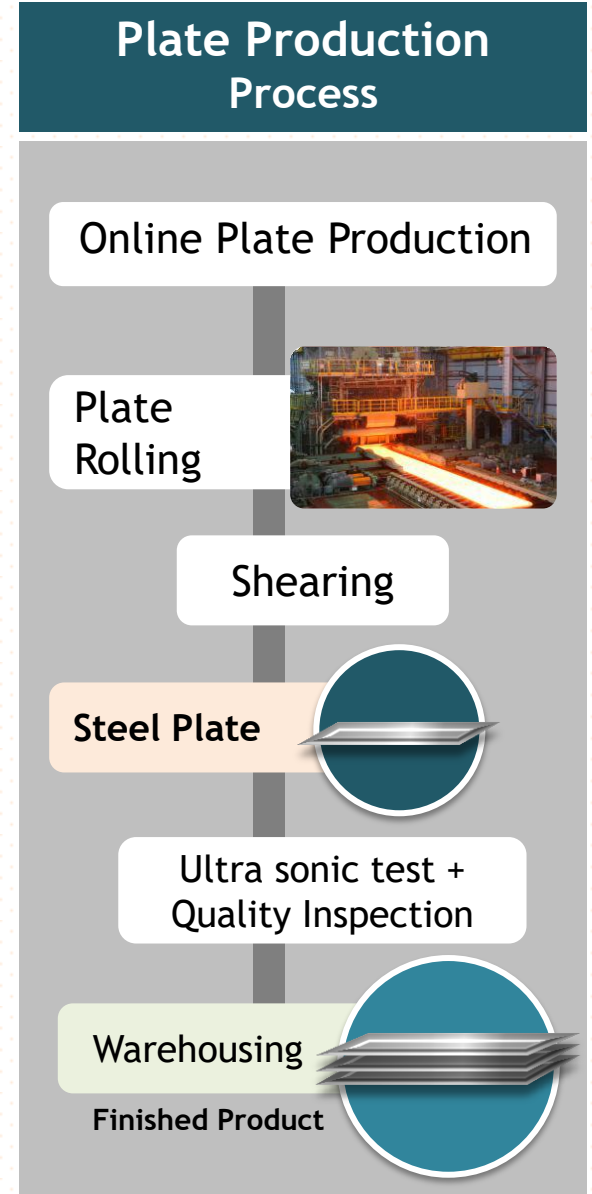


Plate Production Process



○ **RELEASED NEW INDONESIAN REGULATION NO. 22/2021**

Mention steel slag is categorized as registered non hazardous waste (code N101) replace previous regulation 101/2014

● Key points :

- Utilizer & transporter no need to have hazardous waste utilization & waste transportation permit
- By-product can be utilized as long as there is any standard product (national or international) and it should be mentioned in By-product owner's Environmental permit

Steel Industry can expand Steel Slag Utilization to many business sectors

○ **RELEASED INDONESIAN STANDARD & GUIDELINES AND MINISTER DECREE**

SNI released by Indonesian Government related Steel Slag Utilization

Ministry of Public Works Guideline

Instruction of Minister of Public Works and Housing

● Key points :

- Utilizer has guideline to use steel slag for slag cement and civil works
 - Slag aggregate : 2 (SNI 8378:2017, SNI 8379 : 2017)
 - Slag to cement : 4 (SNI 7064:2014, SNI 7064:2014, SNI 6385:2016, SNI 8363:2017, SNI 8912:2020)
- Decree & Guidelines : No. 4/IN/M2020, Pd 13-2016-B, Pd 14-2016-B

BY-PRODUCT BALANCE

○ BY-PRODUCT BALANCE (Non Hazardous)

By classifying and improving of by-product management gradually, Steel Industry has opportunity to get best management in term of increase value of by-product

By-product	By-product management	
	As was (2019)	To be (2022)
GBFS	Cement as clinker substitution	Cement as clinker substitution (94%), concrete aggregate (5%), Floor tiles (1%), soil amendment*
ACS	Civil works	Civil works
Steel making Slag	Steel making & Sinter as Fe source (15%), Civil Works (23%)	Steel making & Sinter as Fe source (25%), Civil works (32%), cement as admixture & Fe source (43%)
Others (used conveyor, etc.)	External utilization	External utilization

BY-PRODUCT BALANCE

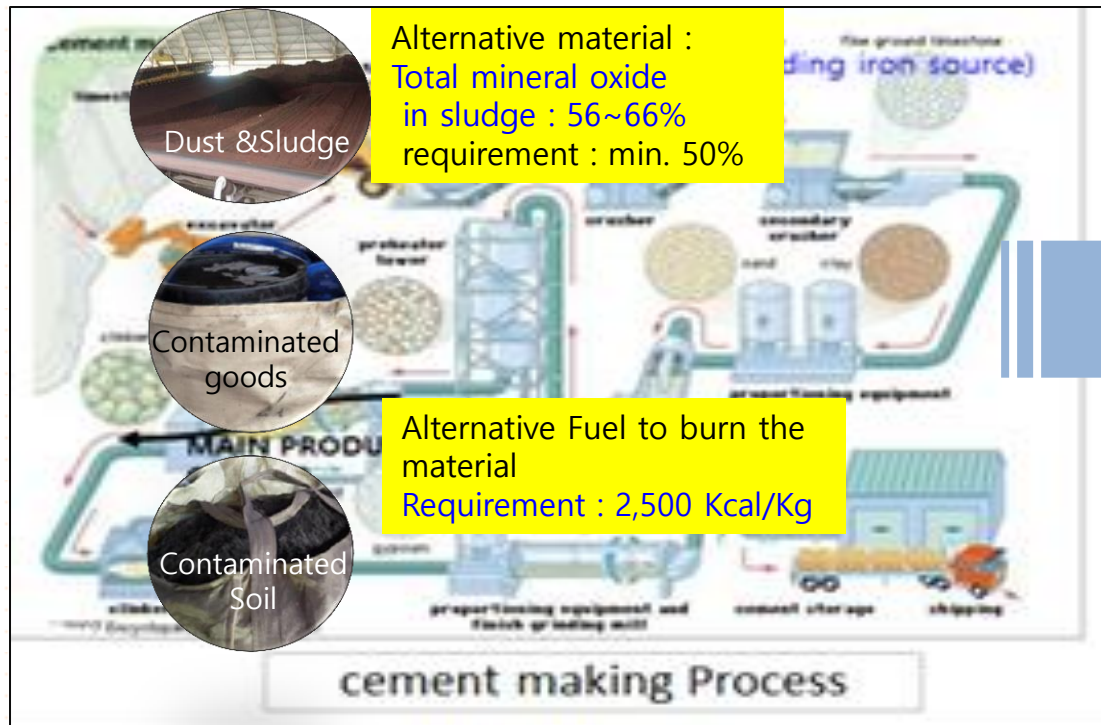
○ BY-PRODUCT BALANCE (Hazardous)

By classifying and improving of by-product management gradually, Steel Industry has opportunity to get best management in term of increase value of by-product

By-product	By-product management	
	2019 (As Was)	2022 (To be)
Dust & Sludge	Steel making & Sinter (90%), Landfill (10%)	Steel making & Sinter (90%), Cement as Fe source (10%)
Mill scale	Steel making	Steel making
Others (waste oil, etc.)	Landfill	Cement as alternative fuel (77%) , incinerator & landfill (23%)
Total Recycling ratio	80%	99.9%

BUSINESS EXPANSION - CONVERTING METHOD LANDFILL TO UTILIZATION

- [Sludge] Convert type of by-product management : landfill → cement
 - Before '19 Sludge is treated as external landfill & incinerator
 - '19 – Analyze chemical components of sludge & succeed to develop by-products new utilization to cement
 - ☞ understanding utilizer process, needs & see opportunity similarity of components inside by-product



Cooperate with permitted cement company

- Sludge [B309-5]
- Cont. goods & soil [A108D]

Refer to Indonesian Regulation No. 22/2021

BUSINESS EXPANSION - DEVELOPING BY-PRODUCT UTILIZATION WITH HIGH VALUE ADDED

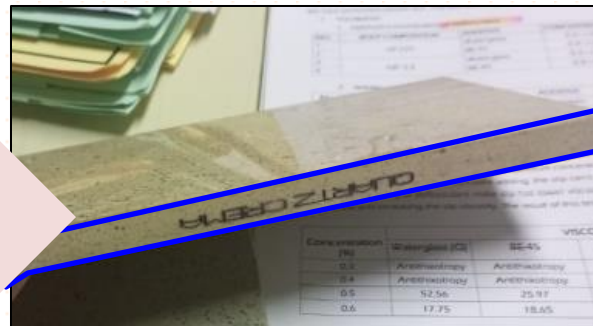
○ [GBFS] Utilization to Filler of floor tiles

- Mostly GBFS is utilized as cement material after grinding
- New utilization to body Floor tile company since April 2022
 - ☞ GBFS has similar component with white sand in term of CaO and SiO₂
 - ☞ GBFS after grinding will be mixed max. 19% with white sand

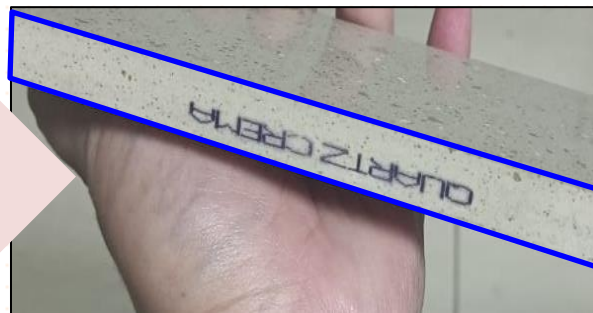
Material



Application



Content	Reference	GBFS
CaO (%)	39.5	43.3
SiO ₂ (%)	33.2	35.2



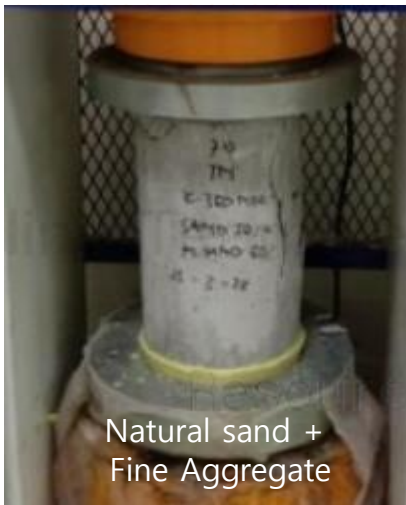
GBFS value increase become 12 times than selling value to cement

BUSINESS EXPANSION - DEVELOPING BY-PRODUCT UTILIZATION WITH HIGH VALUE ADDED

○ [GBFS] Utilization to concrete aggregate

GBFS has similarity with natural sand which limited sources in nature
50:50 of GBFS with fine aggregate can generate compressive strength as required in concrete specification

Comparison Strength Natural sand + fine aggregate vs. fine aggregate +GBFS



Application



Nat' Sand (%)	M-Sand (%)	GBFS (%)	Compressive strength 28d (MPa)
50	50	-	56.32
-	50	50	52.36
Requirement standard			50.00

BUSINESS EXPANSION - DEVELOPING BY-PRODUCT UTILIZATION WITH HIGH VALUE ADDED

○ [GGBFS] Utilization as soil amendment

Chemical content and alkali characteristic of slag as consideration to substitute dolomite as main material for soil amendment

Field test is done for corn farm. The result shows productivity yield of corn with GGBFS is higher than dolomite

Comparison	Productivity (ton/Ha)	Gap (%)	Remarks
Soil (as reference)	9.07	-	
Soil + dolomite	11.2	23.5	By dose 4 tons/Ha
Soil + GGBFS	15.28	68.4	By dose 2 ton/Ha

Table. Comparison of Soil amendment dolomite vs. GBFS

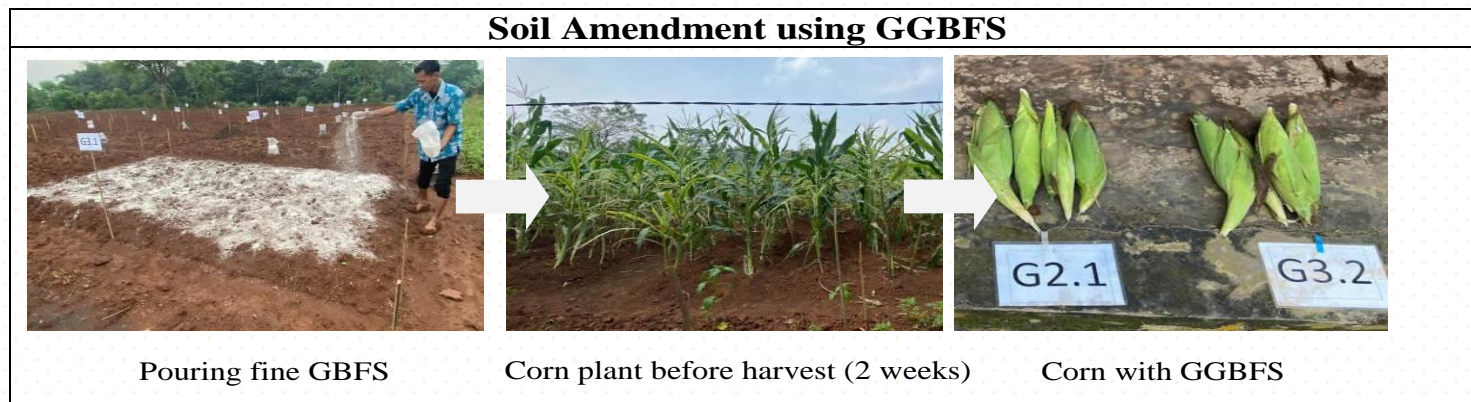
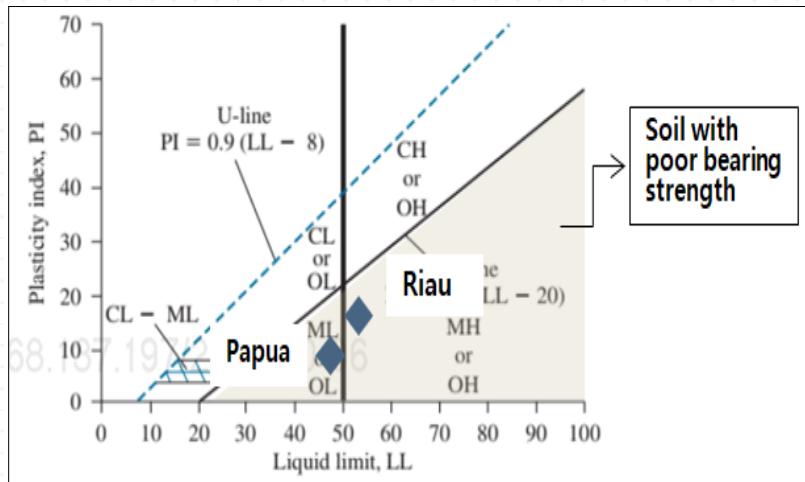


Figure. Pouring process of GGBFS to corn farm

BUSINESS EXPANSION - DEVELOPING BY-PRODUCT UTILIZATION WITH HIGH VALUE ADDED

- **[STEEL MAKING SLAG] Utilization as the soft soil improvement** under size of slag can be utilized to improve soil. It can replace common material such as cement and mortar which non-renewable material mixing design 70% original soil and 30% Slag can generates CBR : 9.4%

Comparison	CBR (%)	
	Papua	Sumatra (Riau)
Original Tested Soil	5.6	4.9
Slag -8 + Original Soil	7.4	9.4
Requirement soil layer	Min. 6	



Graph. Soft soil properties

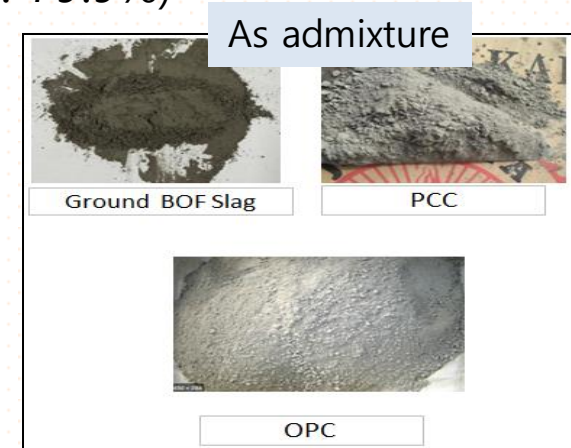
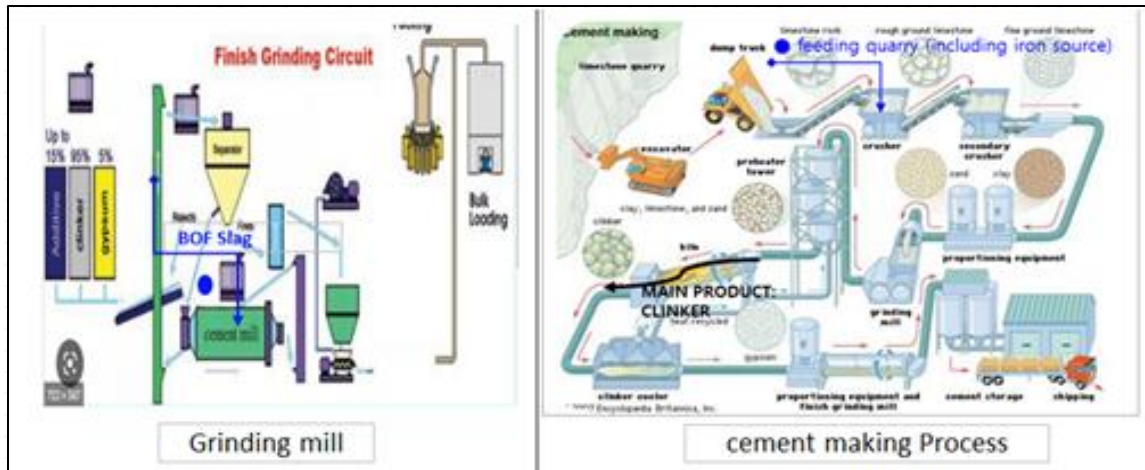
Benefit :

- ☞ Slag -8mm is used and mixed together with soil **Improve bearing strength** of original soft soil
- ☞ Soft soil stabilized with Slag can be **utilized as subgrade** for road construction (CBR min. 6%)
- ☞ Slag **reduced potential of swelling and shrinkage** of soil caused by water with the increase of Slag ratio
- ☞ Slag inclusion **reduce required water** for compaction as shown with Optimum Moisture

BUSINESS EXPANSION - DEVELOPING BY-PRODUCT UTILIZATION WITH HIGH VALUE ADDED

- **[STEEL MAKING SLAG] Utilization as cement material (Fe and mineral source)**
 Slag -8 mm can be used as Fe source (Before Kiln) and Slag +8 mm can be used as admixture material (after kiln)

- For admixture : total mineral of Slag : 96% (Pozzolana : 86%)
- For Fe source : Fe_2O_3 of Slag : 50~69% (Iron sand : 79.9%)



Requirement for admixture		SNI 7064-2014	Actual
Compressive strength (kg/cm ²)	3 days	Min. 130	200
	7 days	Min. 200	260
	28 days	Min. 280	350
Blain (cm/g)		280	413
Mixture (%)		Clinker min. 65, Additive : Gypsum 3 Limestone 20 Pozzolana 12	Clinker min. 65, Additive : Gypsum 3 Limestone 17 BOF Slag 15

BUSINESS EXPANSION - DEVELOPING BY-PRODUCT UTILIZATION WITH HIGH VALUE ADDED

○ [STEEL MAKING SLAG] For Paving Block

Slag 0-8 mm has same characteristic with sand and fine aggregate. Thus, it can substitute both material without reduce the quality of paving block

Slag can reduce up to 35% of mixture sand and fine aggregate



Figure. Paving Block making process

Paving block (%)	Stone ash	Sand	Slag	Strength Kg/cm ²	Remarks
Original	70	30	-	≥ 250	Strength standard SNI 03-0691-1996
PTKP Paving	35	-	65	265	

Table. Composition of Paving Block raw material



- Steel By-product has potential to increase the value through developing utilization
- Learn about by-product characteristic is one of key factor to expand utilization
- Innovative and creative approach needed to keep utilization stably and leading advance utilization
- Thus, target of 100% by-product recycling can be reached which benefit to the company in term of image as a reflection of green steel industry

감사합니다
Terima Kasih
Thank you