

Singapore

August 28-30, 2018

IRSET

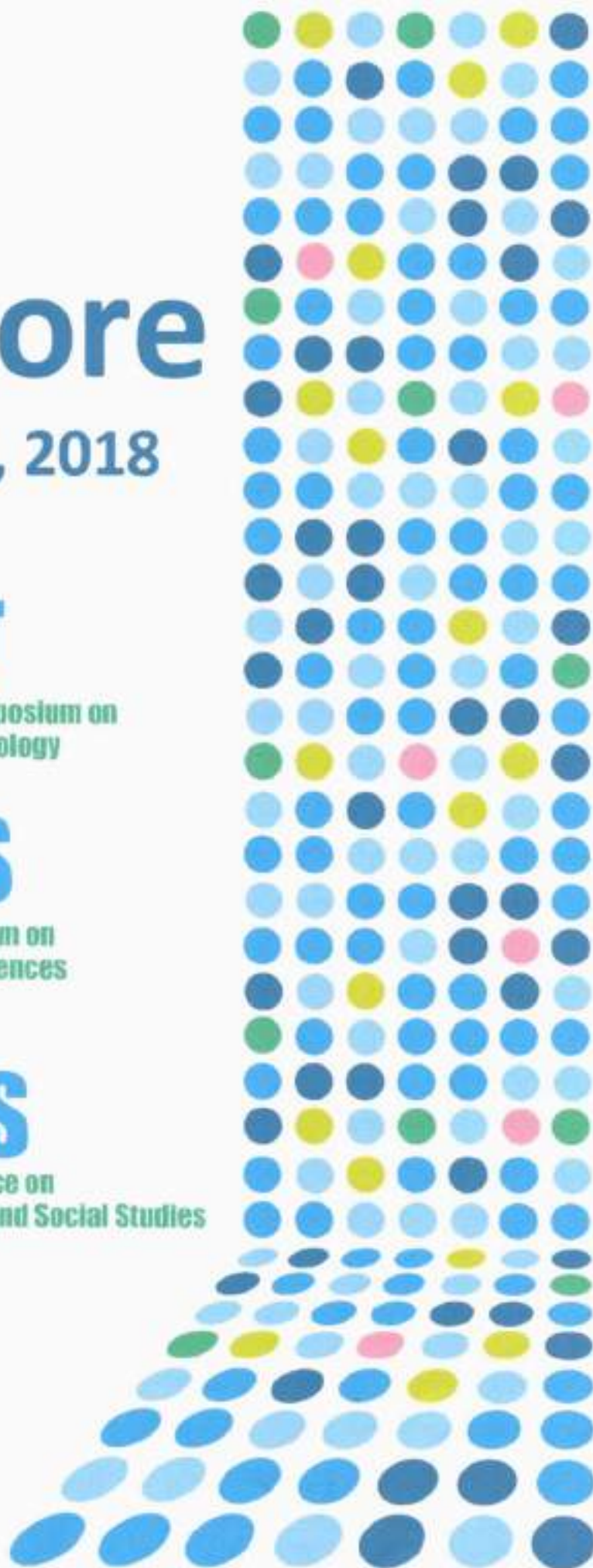
International Research Symposium on
Engineering and Technology

ISBSS

International Symposium on
Business and Social Sciences

ICEEPS

International Conference on
Education, Economics, Psychology and Social Studies



Conference Proceedings

August 28-30, 2018

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Welcome Message



Local Host

Dr. Tan Khay Boon

Department of Economics
SIM Global Education

Dear delegates,

It is my pleasure to welcome you all to "Lion City" Singapore.

Singapore is known as the "Lion City", as legend states that a Prince from Riau Islands first set foot in Singapore, witness a lion ran across a forest and has named the place Singapura, which means lion city. It was previously known as Temasek, a small fishing village. The combination of a lion head and a fish tail, represents both lion and sea, has created the Merlion as the symbol of Singapore. Overtime, Singapore has transformed to a modern and vibrant international city state. It is famous for its efficient port and shipyard services and has been consistently ranked the busiest port in the world. Two local companies, Keppel and Sembawang are the top two offshore marine companies in the world. It is also the oil hub in Asia and it is amongst the world top 5 oil refinery centres. Besides being a major financial centre in Asia, it is also well known for its retail, education, tourism and medical services. Many MNCs have set up regional headquarters and representative offices or in Singapore to facilitate business interactions in the region due to its strategic location, efficient government services, pro-business policies, well connected infrastructure and also productive human resource.

The weather in Singapore is usually warm, just like our feeling towards visitors to our country. Singapore is one of the top visited countries in South-East Asia. Although it is a small country with about 720 square km, the tourist attractions are scattered all over the country. It is best to explore Singapore through its highly modernized mass rapid transit (MRT) systems and its well-connected and extensive bus routes. The famous tourist attractions include Singapore Zoological Garden, Night Safari, River Safari, Merlion Park, Gardens by the Bay, Sentosa and the two integrated resorts, among others.

The Orchard Road district is the most popular shopping district in Singapore. It is usually engulfed by thousands of tourists and locals every night. The major shopping centres and prominent retail outlets will be able to fulfil the requirements of shopping enthusiasts from all over the world. Consumers can get access to famous branded products at reasonable prices in the shopping outlets in Orchard Road.

When in Singapore, do not miss the opportunity of trying out the local food. The multi-racial culture and open to international investments has resulted in the availability of large varieties of food. Besides the establishments of restaurants offering Chinese, Western, Japanese, Malay and Indian food, there are many hawker centre offering authentic local food at very reasonable prices to satisfy the gourmet desires of the visitors.

The education system in Singapore is well-regarded by neighbouring and international countries. Every year, numerous students from the neighbouring and international countries enrol into the schools, polytechnics and universities in Singapore. The students pursue education at all levels, from certificate to diplomas and to undergraduates and even postgraduate programmes in the public and private institutions in Singapore. The two top government-funded autonomous universities, National University of Singapore and Nanyang Technological University are consistently ranked among the highest in international rating. The country is also a favourite host of international meetings, incentives, conferences and exhibitions.

So it is time to pack your luggage and come to Singapore.

It is my pleasure to welcome you all to our forthcoming conference. Besides delivering impactful conference presentations and benefits from knowledgeable and fruitful discussion, we hope that you will also be able to enjoy the warm hospitality offered in Singapore. We sincerely hope that you will come to Singapore and participate in the conference.

Yours sincerely,
Tan Khay Boon Ph.D.

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Special Thanks to Session Chairs

Bob Barrett	<i>American Public University</i>
Andrew Keong NG	<i>Singapore Institute of Technology</i>
Khairil	<i>Syiah Kuala University</i>
Tan Khay Boon	<i>Singapore Institute of Management Global Education</i>
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Jeeyoung Shin	<i>Sookmyung Women's University</i>
Mikio Sasaki	<i>Hachinohe Institute of Technology</i>

Conference Schedule

Tuesday, August 28, 2018		
Time	Schedule	Venue
14:00-16:00	Pre-Registration	Foyer Area, 5F

Wednesday, August 29, 2018		
Oral Session		
Time	Schedule	Venue
08:30-16:00	Registration	Foyer Area, 5F
09:00-10:30	Education (1)	Clove Room, 5F
	Civil Engineering (1)/ Environmental Science (1)	Nutmeg Room, 5F
10:30-10:45	Tea Break & Networking	Foyer Area, 5F
10:45-12:15	Social Sciences Keynote Address [1] Dr. Tan Khay Boon <i>Topic: Finance Development and the Economic Growth Nexus: The Singapore Experience</i> [2] Dr. Bob Barrett <i>Topic: Multi-Generational Transformations of Business and Educational Workplaces in the Creation of Stronger Working Relationships and Bonding</i>	Clove Room, 5F
	Natural Sciences Keynote Address Dr. Andrew Keong NG <i>Topic: Towards Condition Monitoring and Prognosis of Railway Track</i>	
	Environmental Science (2)/ Fundamental and Applied Sciences/ Mechanical Science and Engineering (1)	Nutmeg Room
12:15-13:15	Lunch Time	The Square Restaurant, 7F
13:15-14:45	Education (2)/ Communication	Clove Room, 5F
14:45-15:00	Tea Break & Networking	Foyer Area, 5F
15:00-16:45	Society/ Culture/ Education (3)	Clove Room, 5F

Environmental Science (2)/ Fundamental and Applied

Sciences/ Mechanical Science and Engineering (1)

Wednesday, August 29, 2018 10:45-12:15 Nutmeg Room

Session Chair: Prof. Khairil

IRSET-0141

Effect of Coal Blended on the Physical Properties of Iron Ore Briquette for Direct Reduction Iron

Khairil | *Syiah Kuala University*

Samsul Bahri | *Syiah Kuala University*

Nurdin Ali | *Syiah Kuala University*

Sarwo Edhy Sofyan | *Syiah Kuala University*

Jalaluddin | *Syiah Kuala University*

IRSET-0096

Removal of Highly Water-Soluble Cr (VI) Into Cr (III) Species Using Electrocoagulation Process

Anshu Yadav | *Guru Gobind Singh Indraprastha University, Delhi*

Vinita Khandegar | *Guru Gobind Singh Indraprastha University, Delhi*

IRSET-0104

Effect of Co-Existing Ions on Denitrification by Electrocoagulation of Groundwater

Sanigdha Acharya | *Guru Gobind Singh Indraprastha University, Delhi*

S.K. Sharma | *Guru Gobind Singh Indraprastha University, Delhi*

Vinita Khandegar | *Guru Gobind Singh Indraprastha University, Delhi*

IRSET-0138

Sr-Nd-Pb Isotopic Characteristics of the Lamprophyric Rocks from Konya (Central Anatolia-Turkey)

Kürşad Asan | *Selçuk University*

Hüseyin Kurt | *Selçuk University*

Gülin Gençoğlu Korkmaz | *Selçuk University*

Mesut Gündüz | *Selçuk University*

IRSET-0139

The Hydrological Budget Parameters Deduced from Hydrogeological Investigation of the Kulu Area (Konya-Central Anatolia)

Ali Ferat Bayram | *Selçuk University*

IRSET-0145

Water Resource Management in the Liberian District of Costa Rica

Svetlana Nikolaeva | *National University of Costa Rica*

G. Moraga | *National University of Costa Rica*

Effect of Coal Blended on the Physical Properties of Iron Ore Briquette for Direct Reduction Iron

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Abstract

Iron production by using the direct method has been promoted in order to produce iron effectively, low cost, and environmentally safe. The method was optimal requirements with respect to the feed materials especially iron ore, coal as well as a binder. In this study, the experiments were conducted on physical properties of iron ore briquette from Aceh (Indonesia) to analyze its suitability to meet the feed requirements for iron production. The term iron ore briquette refers to the materials compressed under high pressure formed by variable mixtures of iron ore, coal and binders. In the experiments, the physical properties such as the tumbler index (TI), abrasion index (AI) and shatter indices of the iron ore briquette were carried out. The experimental results show that the iron ore briquette blended with coal and using asphalt as a binder has a high tumbler index (TI) or not easily breakable compared to the iron ore briquette using dammar powder as a binder. On the other hand, the blended coal in iron ore briquette with dammar powder as the binder significantly increases the shelter index or easily breakage.

Keywords: Iron ore briquette, physical properties, direct reduction iron

1. Background

The iron and steel industry has become the top priority of Indonesian government in order to meet national iron and steel demand. Iron production by using direct reduction methods has been promoted in order to produce energy-saving, low cost and environmentally friendly iron. Direct reduction refers to the use of gas or solid reductant in the reaction of iron ore reducing into metallic iron below of the melting temperature. The products are called direct reduced iron (DRI). The coal-based direct reduction process makes ferric oxide metallic Fe into metallic iron under the solid state. Some coal-based iron ore direct reduction processes are based on the formation of composite pellets or briquette which consists of a mixture of fines of iron-bearing oxide, carbonaceous material, for example, coal, coke, or char and a small amount of binder. As an example, by producing briquette which consists of a mixture of fines of iron ore - coal and either dammar powder or asphalt as a binder. It has been utilized as new feed materials for iron reduction.

As well known that some of the researchers have reported on iron ore - coal briquette composite as a feeding material for direct reduction iron processes. The research has grown from the decade 1980s to up to date. Historical development and background of direct reduction processes were reported (Feinman J., 1999). He suggested developing a coal-based direct reduction process that has lower gangue and low sulfur in the product. Characterization of the physical and metallurgical properties of natural iron ore for iron production was reported (Abraham J.B. et al., 2012). It was found that the natural iron ores from Muko deposits can be efficiently used as natural materials for the production of pellets and sinters. The influence of temperature and time on reduction behaviour in iron ore-coal composite pellets size of about 15 mm was also reported (Yi M et al., 2014). The results reveal that the reduction process is diffusion controlled below 900 °C. Interest in iron ore briquette composite as new feed for iron production was reported (Dutta SK., 2017) because some of the advantages are achieved such as very fast reduction rate due to intimate contact between reductant and oxide particles, hence productivity of iron production has drastically increased. In this paper, we investigate the effect of coal blended on the physical properties of iron ore briquette as new feeding materials for the furnace of direct reduction iron.

2. Methods

2.1 Briquette Production Process

The sample of briquette consists of iron ore, coal and dammar powder as well as asphalt as a binder. The coal is sub-bituminous coal originated from Kuala Beu Kabupaten Aceh Barat (Aceh, Indonesia). While, the iron ore is from Lhong (Aceh Besar District, Indonesia). It has about 39.6 % of Fe content. Properties of the iron ore and coal are shown in Table 1. The sub-bituminous coal and iron ore were dried and crushed to the mesh 5 (size 4 mm) separated by a hand sieve before mixing together. The composition of sub-bituminous coal content in iron ore briquette was varied according to the mass percentage of coal and either dammar powder or asphalt as a binder with 5 % of fixed mass percentage.

Table 1: Properties of iron ore and coal tested

Samples	Proximate Analysis [mass %, wet basis]				Ultimate Analysis [mass %, dry basis]					Fe [mass %]	Calorific value [kcal/kg]
	Moisture	VM	FC	Ash	C	H	N	O	S		
Coal	7,94	39,77	49,11	3,18	70,07	5,59	1,56	15,89	3,71	3,5	6795
Iron ore	-	-	-	-	-	-	-	-	-	39.6	-

The production conditions and process of the iron ore briquette are shown in Table 2. The mixture of sub-bituminous coal, iron ore and dammar powder was input in a die and compressed under a load of about 15 Ton by pressing machine, respectively. Subsequently, the composite briquette is heated at a mean temperature of about 150 °C along 30 minutes to make it harden (due to the effect of physical and chemical changes of the binder). On the other hand, the iron ore blended with coal and asphalt as a binder was heated of about 150 °C before inserted in a die and compressed under a load of about 15 Ton by pressing machine, respectively. Photograph of cylindrical iron ore briquette blended with coal is shown in Figure 1. The diameter of bio-briquette was selected 25 mm and height 35 mm respectively.



Fig.1: Photo of iron ore briquette

Table 2: Conditions and process of iron ore briquette

Sample	Percentages of sample [%]	Dia. of briquette [mm]	Height [mm]	Load [ton]
Iron ore – binder	95 - 0 - 5	25	35	15
Iron ore – coal – binder	80 - 15 - 5	25	35	15
Iron ore – coal – binder	70 - 25 - 5	25	35	15
Iron ore – coal – binder	60 - 35 - 5	25	35	15

2.2 Experimental Set up Apparatus

Physical properties such as the breakage, abrasion of the iron ore briquette were carried out by using I-Type tumbler test. The iron ore briquette of each composition was supplied into an I-type tumbler for the degradation test. The schematic diagram of an I-type tumbler test is shown in Fig.2. On the other hand, the strength of iron ore briquette or shatter indices was also determined by using drop test. The drop test apparatus, which is the same as that described and illustrated in test method ASTM D-440, consists of a box of 457 mm in width, 711 mm in length, and approximately 381 mm in depth, supported above a rigidly mounted cast iron plate. The iron ore briquette was inserted in the box and drop it at the elevate to 1830 mm above the ground floor. The dropped iron ore briquette will be separated in order to find out the coarse and fine particles by using the sieves specified in wire mesh 5 (4 mm).

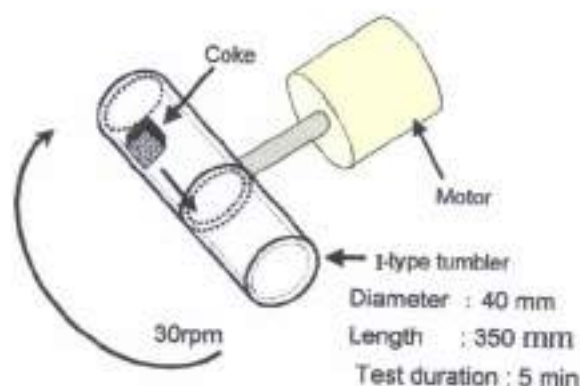


Fig. 2: Schematic diagram of an I-type tumbler test (Khairil *et al.*, 2001).

3. Results and Discussion

3.1 Effect of Coal Blended on the Iron Ore Briquette Breakage

Physical properties of iron ores are determined by using cold strength testing by using I – Type tumbler. A tumble strength test measures two mechanisms of iron ore briquette degradation that is the tumbler index (TI) and the abrasion index (AI). The tumbler index was indicated by means of the breakages of iron ore briquette produced the coarse particles (> 4 mm). On the other hand, the abrasion index was determined by means of the abrasion of iron ore briquette produced the fine particles (< 4 mm). These properties give an indication of the iron ore briquette behaviour during loading, transportation, handling and screening feeding materials. They also give an insight into the material's behaviour, during an initial period of the iron ore briquette reduction process in its descent in the furnace. The percentage of the fractions in proportion to the feed weight is the value of the TI (> 4 mm) and AI (< 4 mm).

Figure 3 shows the profile of the effect of coal blended and binder types on the production of the coarse (> 4 mm) particles. The figure shows that the production of coarse particles depends on the coal blended and binder types. The iron ore briquette blended with coal by using asphalt as a binder show that the fraction of coarse particles almost more than 0.99 mass percentage. It concluded that these iron ore briquettes have high tumbler index (TI) which has strength enough and not easily breakages even though coal was blended. In the case of iron ore briquette blended with coal and using dammar powder as a binder shown that it is easily breakages. When iron ore briquette using dammar powder without blended coal shows the fraction of coarse particles production more than 0.90 mass percentage. It means these briquettes not easily breakages. On the other hand, in case the iron ore briquette blended with coal and using dammar powder as a binder shows that the fraction of coarse particles production less than 10 mass percentage. It is suggested that these iron ore briquettes have low tumbler index (TI) or easily breakage.

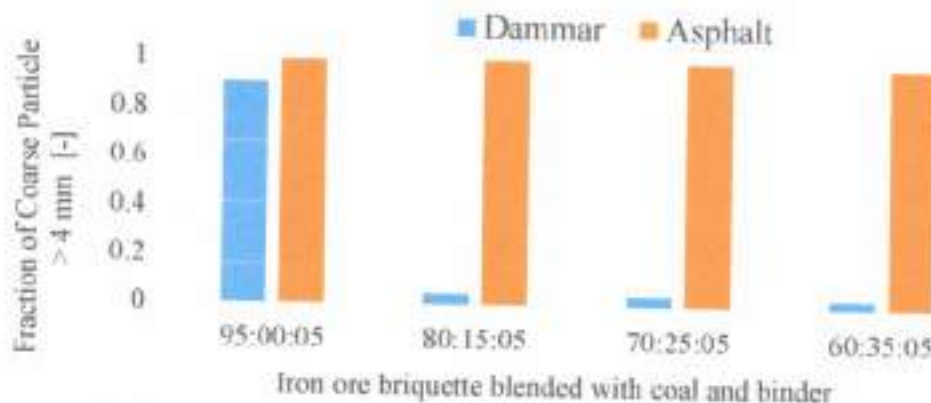


Fig. 3: Profile of the effect of coal blended and binder types on the production of the coarse (> 4 mm) particles by using I- Type tumbler test.

The profile of the effect of coal blended and binder types on the production of the fine (< 4 mm) particles is shown in Figure 4. The iron ore briquette blended with coal by using asphalt as a binder show that the fraction of coarse particles almost more than 0.99 mass percentage. It concluded that these iron ore briquettes have enough strength and not easily breakages even though coal was blended. In the case of iron ore briquette blended with coal and using dammar powder as a binder shown that it is easily breakages. On the other hand, when iron ore briquette using dammar powder without blended coal shows the fraction of coarse particles production more than 0.90 mass percentage. It means these briquettes not easily breakages.

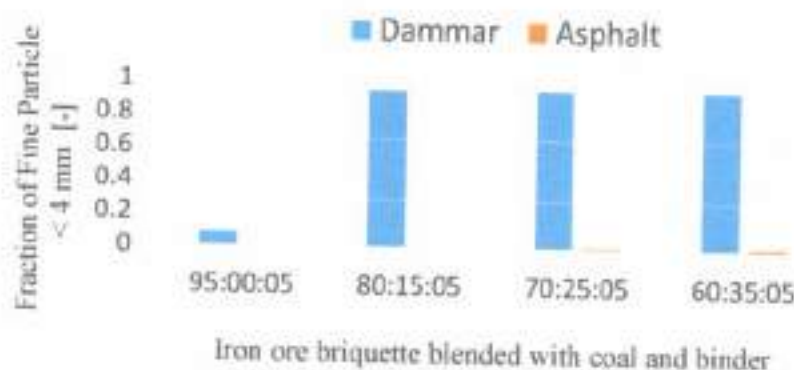


Fig. 4: Profile of the effect of coal blended and binder types on the production of the fine (< 4 mm) particles by using I- Type tumbler test.

3.2 Effect of Coal Blended on Iron Briquette Shatter Indices

The strength of iron ore briquette (shatter indices) was determined by using drop test. The drop test determines the iron ore briquette susceptibility to breakdown due to impact during loading, unloading and charging into the direct reduction furnace. For estimation of a shatter Index, a iron ore briquette blended with coal and material binder of sizes with diameter 25 mm and height 35

mm was dropped by using shelter (457 mm) in width, (711 mm) in length, and approximately (381 mm) in depth from a height of 1.8 m at ceramic floor. Thereafter, the iron ore briquette was screened by using a sieve with mesh 5 (size 4 mm). The shatter index expressed as the wt % passing through a 4 mm sized screen. Profile of the effect of coal blended and binder types on the production of the coarse (> 4 mm) particles by using drop test is shown in Figure 5.

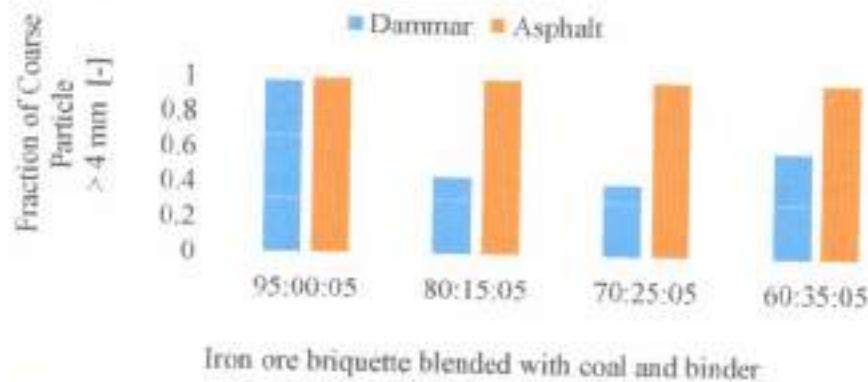


Fig. 5: Profile of the effect of coal blended and binder types on the production of the coarse (> 4 mm) particles by using drop test.

The drop test determines the iron ore briquette susceptibility to breakdown due to impact during loading, unloading and charging into the direct reduction furnace. The iron ore briquette blended with coal and asphalt as a binder shows that the fraction of coarse particles production almost 100 % mass percentage. These means shatter index value of iron ore briquette asphalt binder falling 0.0 mass percentage or not easily breakage, it can be noted that iron ore briquette asphalt binder can hold its form when subject to impact loading. As an example, the shatter index values of 10 commercial iron ore samples from ten different mines of Orissa in India were between 0.68 wt% to 1.80wt% (M. Kumar *et al.*, 2008). Comparison with these iron ore briquette blended with coal and dammar powder binder shows that the fraction of coarse particles production about 40 % to 60 % mass percentage. It was suggested these iron ore briquette easily breakage.

Profile of the effect of coal blended and binder types on the production of the fine (< 4 mm) particles by using drop test is shown in Figure 6. It is shown that blended coal in iron ore briquette with dammar powder binder affect to produce fine particles. The iron ore briquette using dammar powder binder without blended coal shows a small amount of fine particles production. It suggested that these iron ore briquette not easily abrasion. On the other hand, the iron ore briquette blended with coal using dammar powder binder shows a large amount of fine particles production. It suggested that these iron ore briquette easily abrasion. In this case that these iron ore briquette not suitable for feeding to direct reduction furnace due to shatter index value is outside the range of the preferred shatter index value for iron ore for coal-based

reduction is <5wt% and for the Midrex process is less than 10wt% (Sponge iron report, 2010).

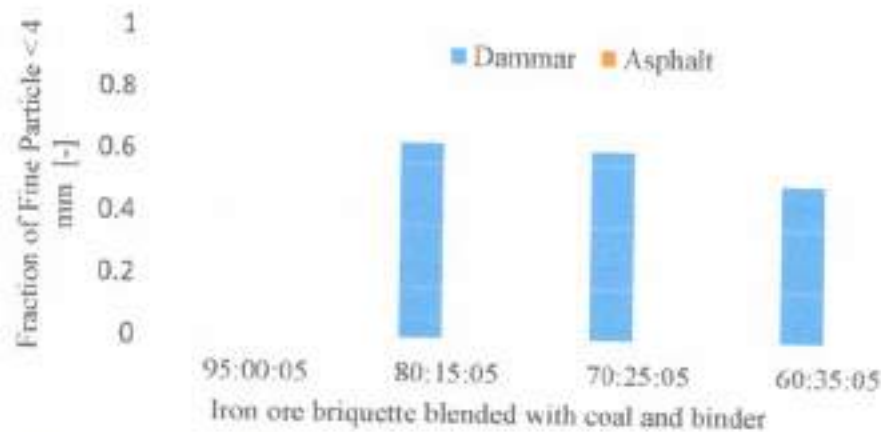


Fig. 6: Profile of the effect of coal blended and binder types on the production of the fine (< 4 mm) particles by using drop test.

3.3 Acknowledgments

The author wishes to acknowledge with many thanks to Syiah Kuala University, Minister of national education for financing the research through the Research Professor Program No.: 287/UN11/SP/PNBP/2018. To appreciate many thank for bachelor student (Muhammad Syukur Zahlul and Andre) in combustion laboratory of mechanical engineering who has supported to conducting the research.

3.4 Conclusion

Effect of coal blended on the physical properties of iron ore briquette for direct reduction iron was carried out by using two test methods. The several findings from this study are concluded as follows:

- (1) The iron ore briquette blended with coal and using asphalt as a binder have a high tumbler index (TI) or not easily breakage compare to the iron ore briquette using dammar powder as a binder.
- (2) The blended coal in iron ore briquette affect to decreasing of strength significantly or increasing of abrasion index (AI) for using dammar powder as a binder.
- (3) The iron ore briquette blended with coal and using asphalt as a binder have a low shelter index or not easily breakage compare to the iron ore briquette using dammar powder as a binder.

- (4) The blended coal in iron ore briquette renders a significant increase in shelter index or easily breakage for using dammar powder as a binder.

4. References

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