（**Translation of attached newspaper article**）

CWM by dewatering lignite efficiently and economically

Three Japanese companies succeeded in developing reforming device

Opened the door to an abundant raw material for the next generation energy sources like DME

Three Japanese companies -KEM, Suzuki Shoko and Japan Systematization Laboratory- have developed a device with a new technology for dewatering and reforming lignite into easy to use Coal Water Mixture (CWM). Prospect for commercialization of the technology was proved by a pilot plant with processing capacity of 30 kg/h. Obtained CWM can be used as conventional pulverized coals by dewatering and further be converted to the next generation energy sources such as hydrogen and DME in combination with a coal gasifier. Three companies will start marketing the technology and designing commercial plant with processing capacity of 5 t/h. Lignite is abundant but difficult to use widely due to its high water content. The new technology will open doors to lignite for substituting oil in many areas.

The device has a transversely mounted cylindrical-shaped pressure vessel in which is a pair of screw-like agitating propeller opposed vertically. Under pressure, the propeller in the center of the vessel kneads lignite. This process needs pressure (approximately 3 mega Pascal) in approximately 200℃ and shearing stress as high as 0.5 mega Pascal to the lignite.

In coal, molecules of water are connected with coal by van der Waals, force or are trapped in pores of the coal. By applying new technology, water is squeezed from the coal destroying the pores so that water molecules are prevented from being connected again.

Dewatering of Loy Yang Coal in Australia with water content 60% gives slurry as low as CWM of bituminous coal in calorie.

Lignite is an abundant resource. For example, volume of reserve for Loy Yang Coal (water content 60%) is 200 billion tons and for Mulia Coal in Indonesia (water content

35%)is 1 billion tons. However, low combustion efficiency and high transportation cost prevent Japan from using lignite abroad. Under dewatering technologies proposed so far such as hot air drying method and thermal dewatering method, processing cost is too high to go into the market. The new technology makes possible to take advantages of lignite with low sulfur, nitrogen and ash for less inverse influence to the environment.

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エネルギー／機械／エンジニアリング

褐炭を脱水、ＣＷＭに

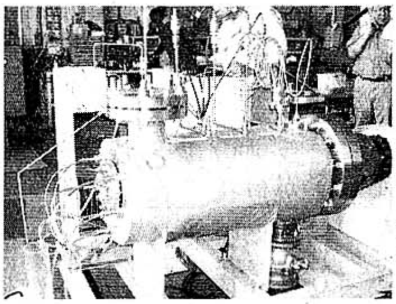
鈴木商工など３社が改質装置開発

ＤＭＥなど次世代エネ原料へ応用

ケー・イー・エム（片山恵子社長）、鈴木商工（渡邉純一社長）、日本システム化研（井上敏社長）の三社は、褐炭の脱水・改質装置を開発した。低品位褐炭を効率よく低コストで脱水し、有効利用しやすいＣＷＭ（石炭・水スラリー）にする改質技術で、パイロットスケール（毎時三十キログラム）を用い実用化にめどをつけたもの。微粉炭用途のほか、石炭ガス化や水素ガス・ＤＭＥ（ジメチルエーテル）向けなど次世代エネルギー向けに応用できるとして、マーケティング活動に入るとともに、事業化に向け実用機（毎時五トン）の設計作業に入る。これまで高含水率から未利用だった褐炭の有効利用に向けた道が開かれると期待される。

開発に成功した装置は、横置き円筒形の加圧容器内に、スクリュー状撹拌羽根一対を対向に配置、投入された褐炭は撹拌されながら容器中央部分で圧縮混練する。処理条件は約二百度Ｃで加熱、三メガパスカル程度まで加圧しながら、〇・五メガパスカルといった高いせん断力を作用させる。ファンデルワールス力結合や細孔組織構造の石炭中の水分子を搾り出すように遊離、組織破壊で再結合を抑制することがポイント。これによって、豪州ロイヤン炭（含水率六〇％）を九％以下まで脱水、褐炭が含んでいた水分のみで、瀝青炭ＣＷＭと同等のスラリーを得られる。

組織破壊で再結合を抑制



ロイヤン炭で二千億トン、インドネシア・ムリア炭（同三五％）で十億トンなどと、豊富な資源である褐炭だが、燃焼効率や輸送コストなどから国内では未利用だった。これまでも脱水技術として気流乾燥法や熱改質法などが提案されていたが、処理コストなどから事業化が難しかった。今回の新技術を導入することで、硫黄や低窒素分・灰分が少ない褐炭の特性を活かせるうえ、ＣＷＭを乾燥すれば自然発火性が低い瀝青炭並みの微粉炭が容易に得られる。微粉炭ボイラーや石炭ガス化炉などのほか、現地での水素ガス生産のほか、メタノールやＤＭＥといった次世代エネルギー原料として有効利用が期待される。また、環境負荷低減技術との組み合わせも容易でエネルギーセキュリティ面でもその向上に寄与できそうだ。

Attached material concerning the high shearing stress kneader

Photograph 1 Normal temperature, normal pressure and high shearing stress type Kneader for testing (shearing stress is 0.4-1.0 M Pascal, capacity of 200 liters)

Photograph 2 High temperature, high pressure, and high shearing stress type Kneader for testing (shearing stress is 0.4-1.0 M Pascal, capacity of 30 liters)
(The same device as newspaper announcement)

Photograph 3 Loy Yong CWM

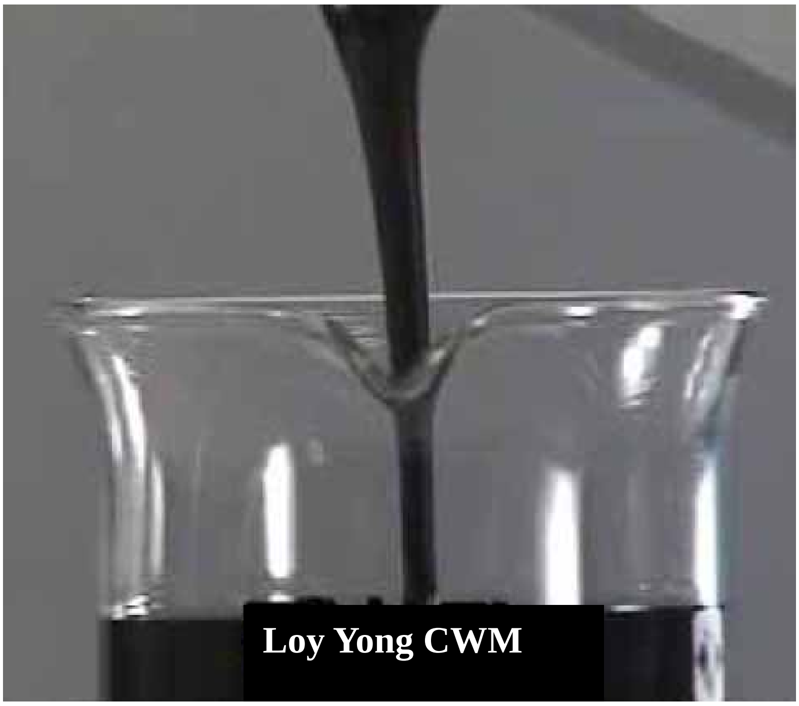
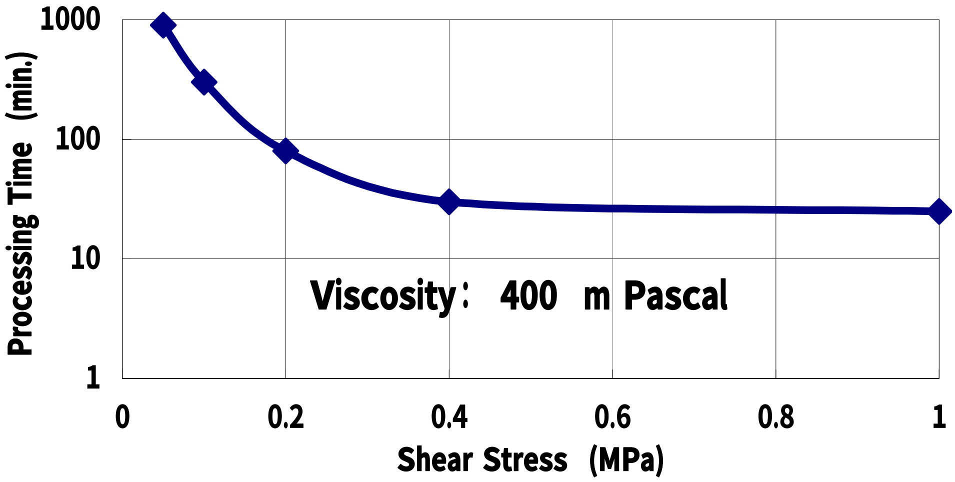


Figure 1 Relation between Shear stress and time of processing

(Loy Yong Brown Coal : Processing Temp. 170℃)



Example of examining economy (based on Canadian lignite)

Table2 Prediction of Economic Effect of CWM Preheating Technology

	KEM Tech. (CWM Preparing Tech.)	KEM Tech. (CWM Preparing and preheating	Effect of preheating Tech.
Coal supply	222 t/h	186 t/h	36 t/h
Oxygen consumption	44 t/h	18 t/h	26 t/h
Cold gasification efficiency	70.07 %	83.39 %	-13.3 %
Reaction time required	2.0 sec	2.7 sec	-0.7 sec
Heat of Syngas (Fix)	500 Gcal/h	500 Gcal/h	0 Gcal/h
Cost of Oxygen (5 mil/Nm^3)	1,540 US$/h	630 US$/h	910 US$/h
Cost of Coal (6 US$/t)	1,202 US$/h	1,007 US$/h	195 US$/h
Total cost of material	2,742 US$/h	1,637 US$/h	1,105 US$/h
CO_2 Tax (40 US$/t·$CO_2$)	2,081 US$/h	1,080 US$/h	1,001 US$/h
Total cost	39 Million US$/year	22 Million US$/year	17 Million US$/year

"Cost evaluations by KEM"

Table 1 Prediction of Economic Effect of KEM's CWM Preparation and Preheating Technology

"Cost evaluations by KEM"

	Conventional CWM Gasification	KEM Tech. (CWM Preparing and preheating	Effect of KEM's Tech.
Coal supply	503 t/h	186 t/h	317 t/h
Oxygen consumption	126 t/h	17 t/h	109 t/h
Cold gasification efficiency	46.40 %	83.39 %	-36.99 %
Reaction time required	2.0 sec	2.7 sec	-0.7 sec
Heat of Syngas (Fix)	500 Gcal/h	500 Gcal/h	0 Gcal/h
Cost of Oxygen (5 mil/Nm^3)	4,410 US$/h	595 US$/h	3,815 US$/h
Cost of Coal (6 US$/t)	1,811 US$/h	1,007 US$/h	804 US$/h
Total cost of material	6,221 US$/h	1,602 US$/h	4,619 US$/h
CO2 Tax (40 US$/t·CO2)	7,200 US$/h	1,080 US$/h	6,120 US$/h
Total cost	107 Million US$/year	21 Million US$/year	86 Million US$/year

CWM Preparation plant cost 100 Million US$

capacity 186 t·CWM/h

CWM Preheating plant cost 130 Million US$

capacity (13.5 t·CWM/h × 14) 186 t·CWM/h

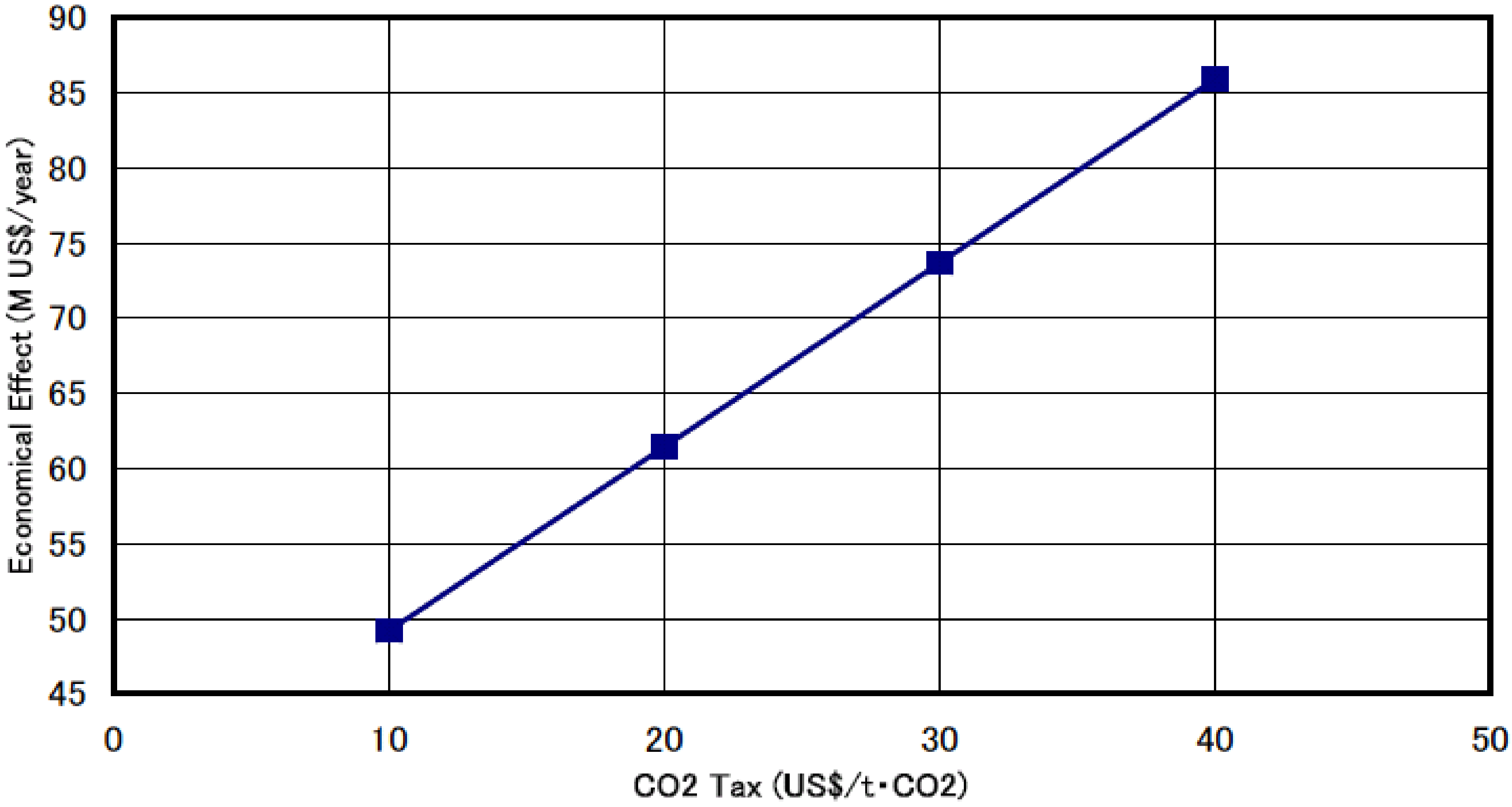
Plant preface

Plant life (=Redemption years) → 7 years

Interest rate → 5%

Inflation rate → 0%

Fig. 1 Relation between Amount of CO2 Tax and Economic Effect



CANADIAN CLEAN POWER COALITION

Saskatchewan Lignite Analysis

Coal Analyses on an as-delivered basis

LIGNITE

Proximate Analysis		Ultimate Analysis	
Component	% by weight	Component	% by weight
Moisture	33.54	Moisture	33.54
Volatile matter	24.39	Carbon	39.58
Fixed carbon	28.61	Hydrogen	2.57
Ash	13.46	Sulfur	0.49
Total	100.0	Nitrogen	0.67
		Oxygen	9.70
Heating value,		Ash	13.46
Btu/lb (HHV)	6,433	Total	100.0
KJ/kg	14,963		

Ash analysis	
SiO_2	45.56
Al_2O_3	20.21
Fe_2O_3	3.61
TiO_2	0.88
CaO	9.34
MgO	2.47
Na_2O	5.36
K_2O	1.17
P_2O_5	0.29
SO_3	9.29
SrO	0.31
BaO	0.42
Undetermined	1.09
Total	100.0