

Figure S1. X.R.D and SEM images of "ZSM-5(50)" represents the $\text{SiO}_2:\text{Al}_2\text{O}_3=50$.

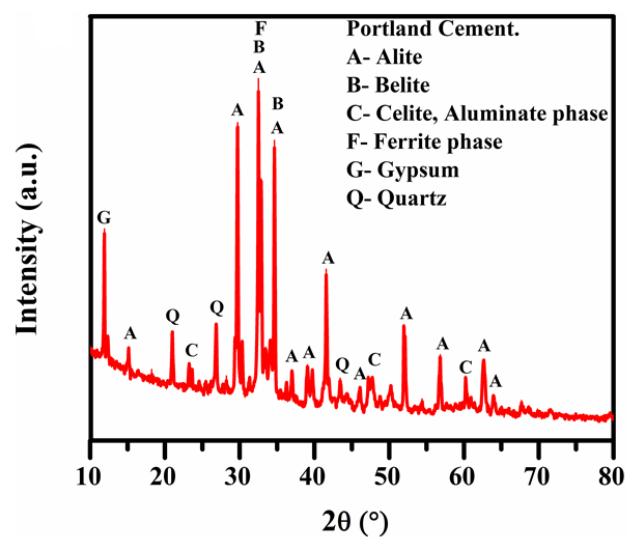


Figure S2. X.R.D pattern of ordinary Cement.

Table S1. Effect of different Catalyst on product gas yield (mL/g).

(T/°C) 600	H ₂ Err	CO Err	CH ₄ Err	CO ₂ Err	C ₂ H ₄ Err	C ₂ H ₆ Err
CEM-ZSM-5 (bed)	45.68 ± 3.15	50.79 ± 3.00	27.44 ± 3.15	105.62 ± 6.00	1.71 ± 0.05	4.38 ± 0.50
Cement (10 wt. %)	40.43 ± 3.00	62.52 ± 4.55	26.37 ± 3.00	99.97 ± 5.65	2.06 ± 0.09	5.28 ± 0.75
ZSM-5 (10 wt. %)	37.95 ± 2.65	55.93 ± 3.75	21.94 ± 2.80	91.47 ± 5.15	2.93 ± 0.15	3.50 ± 0.15
Without catalyst	35.86 ± 2.55	45.90 ± 3.55	21.07 ± 2.75	88.90 ± 5.00	1.34 ± 0.05	3.56 ± 0.15

Table S2. Constituents of biofuel derived from pyrolysis using cement catalyst.

Rice straw Non catalytic pyrolysis		Cement catalytic pyrolysis of rice straw	
Name of Compounds	Relative area, %	Name of Compounds	Relative area, %
Phenol	12.25	Phenol	14.12
P-cresol	10.88	Toluene	13.48
3-butene-2-one-3-methyl-	10.00	Phenol-3-methyl	10.27
Isobutane	9.16	Cyclopentanone-2-methyl	8.43
Naphthalene, decahydro-2, 3-dimethyl	5.69	2- propanone-1-hydroxy	8.08
1, 3-cyclopentadiene, 1-methyl	5.58	P-xylene	6.17
Furane, 2, 3, 5-tri-methyl-	4.83	Benzofuran-2, 3-dihydro	6.13
2,4 –hexadienal	4.04	4-ethyl benzoic acid	4.71
Benzene, 1-ethyl-4-methyl	3.84	Cyclo-pentane-ethylidene	4.28
Benzofuran, 2, 4-dihydro	3.79	2-Naphthalenol	2.93
4-pentene-2-ol	3.76	Styrene	2.77
2-Methylcyclopentene-1, 3-dion	3.39	1H-indene-3-methyl-	2.69
2-pentanal-2-ethyl	3.27	Benzene 1, 3 dimethyl	2.16
oxalic acid allyl octyl ester	3.13	Bicyclo [5, 1, 0] Octane	2.15
Phenol-2-methoxy	2.82	1-Dococene	2.09
Phenol, 3-ethyl-5-methyl-	2.79	Mesitylene	2.09
Styrene	2.52	2, 3-pentane dione	1.68
Phenol, 2-ethyl-5-methyl-	2.42	Phenol-2-methoxy 6-(1-propynyl)	1.28
1H-indene-1-one, 2, 3-dihydro	1.68	7-Heptadecene-17-chloro	1.05
phenol-3,5-dimethyl	1.50	1-Nonadecene	0.97
Tetrahydrofuran	1.08	1- Naphthalenol-2-methyl	0.84
Naphthalene, decahydro-1, 5-dimethyl-	0.98	7-Hexadecene	0.76
2-Cyclopentene-1-one -3-methyl-	0.76		

Table S3. Constituents of biofuel derived from pyrolysis using ZSM-5 catalyst.

Rice straw Non catalytic pyrolysis		Rice straw (ZSM-5) catalytic pyrolysis	
Name of Compounds	Relative area, %	Name of Compounds	Relative area, %
Phenol	12.25	5,9-Dodecadien-2-one, 6,10-dimethyl-, (E,E))-	9.78
P-cresol	10.88	p-Cresol	9.86
3-butene-2-one-3-methyl-	10.00	Phenol	8.85
Isobutane	9.16	2-Propanone, 1-hydroxy-	5.39
Naphthalene, decahydro-2, 3-dimethyl	5.69	1-Decene	6.09
1, 3-cyclopentadiene, 1-methyl	5.58	Benzofuran, 2,3-dihydro-	6.06
Furane, 2, 3, 5-tri-methyl-	4.83	Phenol, 2-methyl-	5.43
2,4 –hexadienal	4.04	p-Xylene	5.56
Benzene, 1-ethyl-4-methyl	3.84	1-Tridecene	4.89
Benzofuran, 2, 4-dihydro	3.79	Toluene	4.83
4-pentene-2-ol	3.76	1-Tetradecene	4.26
2-Methylcyclopentene-1, 3-dion	3.39	Pentadecane	3.96
2-pentanal-2-ethyl	3.27	Nonacos-1-ene	3.82
oxalic acid allyl octyl ester	3.13	2-Cyclopenten-1-one	3.71
Phenol-2-methoxy	2.82	1,13-Tetradecadiene	3.54
Phenol, 3-ethyl-5-methyl-	2.79	Phenol, 4-ethyl-	2.81
Styrene	2.52	Phenol, 2-ethyl-5-methyl-	2.72
Phenol, 2-ethyl-5-methyl-	2.42	Decane	2.16
1H-indene-1-one, 2, 3-dihydro	1.68	1-Undecene	1.95
phenol-3,5-dimethyl	1.50	6-Tridecene	1.37
Tetrahydrofuran	1.08	1-Dodecene	1.11
Naphthalene, decahydro-1, 5-dimethyl-	0.98	1,2-Benzenediol, 3-methyl-	1.53
2-Cyclopentene-1-one -3-methyl-	0.76	1-Nonene	0.32

Table S4. Constituents of biofuel derived from pyrolysis using dual catalytic bed (CEM/ZSM-5).

Rice straw Non catalytic pyrolysis		Dual Catalytic pyrolysis of rice straw	
Name of Compounds	Relative area, %	Name of Compounds	Relative area, %
Phenol	12.25	Phenol, -3-methyl-	14.28
P-cresol	10.88	Benzofuran, 2-methyl-	10.71
3-butene-2-one-3-methyl-	10.00	p-Cresol	9.10
Isobutane	9.16	Phenol, 2-methyl-	6.91
Naphthalene, decahydro-2, 3-dimethyl	5.69	Toluene	6.55
1, 3-cyclopentadiene, 1-methyl	5.58	o-Xylene	6.96
Furane, 2, 3, 5-tri-methyl-	4.83	Phenol, 4-ethyl-	5.33
2,4 –hexadienal	4.04	2-Cyclopenten-1-one, 2-methyl-	4.51
Benzene, 1-ethyl-4-methyl	3.84	2-Cyclopenten-1-one	4.21
Benzofuran, 2, 4-dihydro	3.79	1-Tridecene	3.79
4-pentene-2-ol	3.76	Cyclopropanecarboxylic acid, 1-acetyl-, ethyl ester	3.25
2-Methylcyclopentene-1, 3-dion	3.39	Propenoic acid, 2-trifluoroacetyl-amino-	2.95
2-pentanal-2-ethyl	3.27	Heptadecane	2.31
oxalic acid allyl octyl ester	3.13	2,3-Dibenzyl-5,6-dihydroxypyrimidin-4(3H)-one	2.26
Phenol-2-methoxy	2.82	Eicosane	2.07
Phenol, 3-ethyl-5-methyl-	2.79	Decane	5.59
Styrene	2.52	5-tert-Butylpyrogallol	1.87
Phenol, 2-ethyl-5-methyl-	2.42	Pentadecane	1.72
1H-indene-1-one, 2, 3-dihydro	1.68	Cyclopentanone	1.40
phenol-3,5-dimethyl	1.50	Dodecane	2.67
Tetrahydrofuran	1.08	1-Nonadecene	0.68
Naphthalene, decahydro-1, 5-dimethyl-	0.98	Hexadecane	0.53
2-Cyclopentene-1-one -3-methyl-	0.76	Phenol	0.35