

SEARCH HISTORY

Application Number	PCT/US 18/52102
Search Conducted By	HMA
Search Approved By	SV
US/IPC Classifications Searched	IPC (8): B01D 15/00, B01D 1/00 (2019.01) CPC: C10L 1/00, C10L 1/322, B01 D5/0057, C10K 1/00, C10L 2290/02, Y02E 50/14, B01 D15/00, C10G 25/12, B01J 20/12, C10G 2300/44, Y10S 502/515, B01J 20/34, B01D 11/00
USPC	210/106; 210/502.1
Date Conducted	27 December 2018; 11-12 February 2019
Documentation Searched	PatBase, Patbase (classified), Google Patents, Google Scholar
Search Terms Used	pyrolysis pyrolyzed oil bio-oil biocrude solvent non-polar butane pentane hexane heptane elution eluting bind adsorb adsorption absorb absorption remove separate contaminant unwanted impurities benzoic-acid quinolone steric-acid nitrogen sulfur clean polarity change modify reverse clarify evaporate vaporize clay attapulgate palygorskite activated wash regenerate acetone cycle dry dried column
Date Conducted	27 December 2018; 11-12 February 2019
Electronic Database Searched	PatBase (based on classifications)
Files Searched	Full-text: AU BE BR CA CH CN DE DK EP ES FI FR GB IN JP KR SE TH TW US WO Bibliographic: (Europe) AT BA BE BG CH CS CY CZ DD DK EE ES FI GE GR HR HU IE IS IT LT LU LV MC MD MT NL NO PL PT RO RS SE SI SK SM TR UA YU (Asia) EA GC HK ID IL IN KZ MN MY PH RU SG SU TH TJ TW UZ VN (North America) CA CR CU DO GT HN MX NI PA SV TT (South America) AR BR CL CO EC PE UY (Australasia) AU NZ (Africa) AP DZ EG KE MA MW OA ZA ZM ZW
Date Conducted	27 December 2018; 11-12 February 2019
Search Logic:	

- Search 1: CPC = (C10L1/00 OR C10L1/322 OR B01D5/0057 OR C10C5/00 OR C10K1/00 OR C10L2290/02 OR Y02E50/14 OR B01D15/00 OR B01J20/16 OR C10G25/12 OR B01J20/12 OR C10G2300/44 OR Y10S502/00 OR Y10S502/515 OR B01J20/34 OR B01D11/00 OR B01D1/00) (Results 17128)
- Search 2: 1 and ft = ((pyrolysis OR pyrolyzed) w5 oil) OR biocrude OR bio-oil (Results 861)
- Search 3: 2 and ft = solvent* (Results 288)
- Search 4: 3 and ft = solvent w10 (non-polar OR butane OR pentane OR hexane OR heptane) (Results 38)
- Search 5: 4 and ft = elut* w10 solvent* (Results 2)
- Search 6: 4 and ft = (bind* OR adsorb* OR remov* OR separat* OR absorb* OR absorp* OR adsorp*) w10 (contaminant* OR unwanted* OR impurit* OR benzoic acid OR quinolone OR steric acid OR sulfur* OR nitrogen*) (Results 24)
- Search 7: 6 and ft = pd<20170927 (Results 23)
- Search 8: 7 and ft = (chang* OR modify* OR revers*) w5 polar* (Results 2)
- Search 9: 5 and 7 (Results 2)
- Search 10: 2 and ft = clean* OR clarify* (Results 293)
- Search 11: 10 and ft = (((pyrolysis OR pyrolyzed) w5 oil) OR biocrude OR bio-oil) w5 (clean* OR clarif*) (Results 12)
- Search 12: 11 and ft = pd<20170927 (Results 10)
- Search 13: 4 and ft = (evaporat* OR vaporiz*) w10 (solvent* OR butane OR pentane OR hexane OR heptane) (Results 13)
- Search 14: 13 and ft = elut* (Results 4)
- Search 15: 13 and ft = pd<20170927 (Results 13)
- Search 16: 13 and ft = clay* (Results 3)

- Search 17: 16 and ft = activated attapulgite OR palygorskite (Results 0)
- Search 18: 16 and ft = (adsorp* OR adsorb* OR absorb* OR absorp*) w5 contaminant*
(Results 2)
- Search 19: 18 and ft = (clean* OR wash* OR regenerat* OR activat*) (Results 1)
- Search 20: 19 and ft = acetone (Results 0)
- Search 21: 19 and ft = cycle* (Results 0)
- Search 22: 19 and ft = dry* OR dried (Results 1)
- Search 23: 22 and ft = clay w10 column* (Results 0)
- Search 24: 22 and ft = elut* w5 solvent* (Results 0)

Electronic Database Searched	PatBase
Files Searched	<p>Full-text: AU BE BR CA CH CN DE DK EP ES FI FR GB IN JP KR SE TH TW US WO</p> <p>Bibliographic: (Europe) AT BA BE BG CH CS CY CZ DD DK EE ES FI GE GR HR HU IE IS IT LT LU LV MC MD MT NL NO PL PT RO RS SE SI SK SM TR UA YU (Asia) EA GC HK ID IL IN KZ MN MY PH RU SG SU TH TJ TW UZ VN (North America) CA CR CU DO GT HN MX NI PA SV TT (South America) AR BR CL CO EC PE UY (Australasia) AU NZ (Africa) AP DZ EG KE MA MW OA ZA ZM ZW</p>
Date Conducted	27 December 2018; 11-12 February 2019
Search Logic:	
Search 1:	((pyrolysis OR pyrolyzed) w5 oil) OR biocrude OR bio-oil (Results 7389)
Search 2:	1 and ft = solvent* (Results 2468)
Search 3:	2 and ft = solvent w10 (non-polar OR butane OR pentane OR hexane OR heptane) (Results 286)
Search 4:	3 and ft = elut* w10 solvent* (Results 11)
Search 5:	3 and ft = (bind* OR adsorb* OR remov* OR separat* OR absorb* OR absorp* OR adsorp*) w10 (contaminant* OR unwanted* OR impurit* OR benzoic acid OR quinolone OR steric acid OR sulfur* OR nitrogen*) (Results 148)
Search 6:	5 and ft = pd<20170927 (Results 135)
Search 7:	6 and ft = (chang* OR modify* OR revers*) w5 polar* (Results 5)
Search 9:	1 and ft = clean* OR clarify* (Results 2305)
Search 10:	9 and ft = (((pyrolysis OR pyrolyzed) w5 oil) OR biocrude OR bio-oil) w5 (clean* OR clarif*) (Results 53)
Search 11:	10 and ft = pd<20170927 (Results 41)
Search 12:	3 and ft = (evaporat* OR vaporiz*) w10 (solvent* OR butane OR pentane OR hexane OR heptane) (Results 103)

Search 13: 12 and ft = elut* (Results 26)

Search 14: 12 and ft = pd<20170927 (Results 96)

Search 15: 12 and ft = clay* (Results 22)

Search 16: 15 and ft = activated attapulgite OR palygorskite (Results 0)

Search 17: 15 and ft = (adsorp* OR adsorb* OR absorb* OR absorp*) w5 contaminant* (Results 2)

Search 18: 17 and ft = (clean* OR wash* OR regenerat* OR activat*) (Results 2)

Search 19: 18 and ft = acetone (Results 1)

Search 20: 19 and ft = cycle* (Results 1)

Search 21: 20 and ft = dry* OR dried (Results 1)

Search 22: 21 and ft = clay w10 column* (Results 0)

Search 23: 21 and ft = elut* w5 solvent* (Results 0)

Electronic Database Searched	Google Patents
Files Searched	Google WebSite
Date Conducted	27 December 2018; 11-12 February 2019
Search Logic:	
<p>pyrolysis oil About 149,000 results (0.27 seconds)</p> <p>pyrolysis oil AND adjust polarity About 5,240 results (0.27 seconds)</p> <p>pyrolysis oil AND adjust polarity AND (bind OR adsorb) About 109,000 results (0.32 seconds)</p> <p>(("pyrolysis" OR "pyrolyzed") oil) AND adjust polarity AND (bind OR adsorb) About 5,690 results (0.52 seconds)</p> <p>(("pyrolysis" OR "pyrolyzed") oil) AND adjust polarity with solvent AND (bind OR adsorb)</p>	

About 2,370 results (0.38 seconds)

("pyrolysis oil" OR "pyrolyzed oil") AND adjust polarity with solvent AND (bind OR adsorb)
About 82 results (0.37 seconds)

("pyrolysis oil" OR "pyrolyzed oil") AND adjust polarity with solvent AND (bind OR adsorb)
AND ((bind OR absorption) (contaminant OR unwanted))
About 31 results (0.55 seconds)

pyrolysis oil AND adjust polarity with solvent AND (bind OR adsorb) AND ((bind OR
absorption OR remove) (contaminant OR unwanted))
About 13,600 results (0.43 seconds)

pyrolysis oil AND adjust polarity with solvent AND (bind OR adsorb) AND ((bind OR
absorption OR remove) (contaminant OR unwanted)) clay
About 2,790 results (0.51 seconds)

pyrolysis oil AND adjust polarity with solvent AND (bind OR adsorb) AND ((bind OR
absorption OR remove) (contaminant OR unwanted)) clay AND (elution OR eluting)
About 1,010 results (0.53 seconds)

pyrolysis oil AND adjust polarity with solvent AND (bind OR adsorb) AND ((bind OR
absorption OR remove) (contaminant OR unwanted)) clay AND (elution OR eluting) AND
(separate solvent)
About 1,010 results (0.52 seconds)

pyrolysis oil AND adjust polarity with non-polar solvent AND (bind OR adsorb) AND ((bind OR
absorption OR remove) (contaminant OR unwanted)) clay AND (elution OR eluting) AND
(separate solvent)
About 817 results (0.53 seconds)

("pyrolysis oil" OR "pyrolyzed oil") AND (clean OR clarify)
About 3,540 results (0.19 seconds)

("pyrolysis oil" OR "pyrolyzed oil") AND (non-polar solvent OR butane OR pentane OR hexane
OR heptane)
About 1,950 results (0.34 seconds)

("pyrolysis oil" OR "pyrolyzed oil") AND (non-polar solvent OR butane OR pentane OR hexane
OR heptane) AND ((change OR modify OR reverse) polarity)
About 1,220 results (0.50 seconds)

Your search - ("**pyrolysis oil**" OR "**pyrolyzed oil**") AND (non-polar solvent OR butane OR
pentane OR hexane OR heptane) AND ("**change the polarity**" OR "**modify the polarity**") -
did not match any patent results.

Your search - ("**pyrolysis oil**" OR "**pyrolyzed oil**") AND (non-polar solvent OR butane OR
pentane OR hexane OR heptane) AND ("**changing the polarity**" OR "**modifying the**

polarity") - did not match any patent results.

Your search - ("**pyrolysis oil**" OR "**pyrolyzed oil**") AND (non-polar solvent OR butane OR pentane OR hexane OR heptane) AND ("**polarity is changed**" OR "**polarity is changed**") - did not match any patent results.

(biocrude OR bio-oil) AND ((change OR modify) polarity)

About 2,720 results (0.34 seconds)

Your search - (biocrude OR bio-oil) AND (non-polar solvent OR butane OR pentane OR hexane OR heptane) AND ("**change the polarity**" OR "**modify the polarity**") - did not match any patent results

Your search - ("**pyrolysis oil**" OR "**pyrolyzed oil**") AND (non-polar solvent OR butane OR pentane OR hexane OR heptane) AND ("**changing the polarity**" OR "**modifying the polarity**") - did not match any patent results.

 ("pyrolysis oil" OR "pyrolyzed oil" OR "biocrude" OR "bio-oil") AND ((non-polar solvent OR butane OR pentane OR hexane OR heptane) solvent)

About 3,750 results (0.35 seconds)

("pyrolysis oil" OR "pyrolyzed oil" OR "biocrude" OR "bio-oil") AND ((non-polar solvent OR butane OR pentane OR hexane OR heptane) solvent) AND evaporate solvent

About 2,140 results (0.50 seconds)

("pyrolysis oil" OR "pyrolyzed oil") AND ((non-polar solvent OR butane OR pentane OR hexane OR heptane) solvent) AND evaporate solvent

About 1,030 results (0.50 seconds)

clay AND elution of solvents AND pyrolysis oil

About 17,000 results (0.30 seconds)

clay AND elution of solvent AND ("pyrolysis oil" OR "bio-oil")

About 354 results (0.36 seconds)

(activated attapulgite OR palygorskite) AND clay AND elution of solvent AND ("pyrolysis oil" OR "bio-oil")

1 result (0.39 seconds)

(activated attapulgite OR palygorskite) AND clay AND solvent AND ("pyrolysis oil" OR "bio-oil")

About 80 results (0.36 seconds)

absorption of the contaminants onto clay AND elution of clean oil from solvent

About 9,810 results (0.29 seconds)

absorption of the contaminants onto (clay OR activated attapulgite OR palygorskite) AND elution of clean oil from solvent
 About 1,330 results (0.43 seconds)

absorption of the contaminants onto (clay OR activated attapulgite OR palygorskite) AND solvent
 About 5,700 results (0.38 seconds)

absorption of the contaminants onto (clay OR activated attapulgite OR palygorskite) AND solvent AND ("pyrolysis oil" OR "bio-oil")
 About 22 results (0.55 seconds)

activate clay AND cleaning with acetone after cycle
 About 17,800 results (0.30 seconds)

(activate OR regenerate) by drying clay AND (clean OR wash) with acetone after cycle
 About 3,700 results (0.34 seconds)

(activate OR regenerate) by drying clay AND (clean OR wash) AND cycle
 About 12,400 results (0.41 seconds)

("pyrolysis oil" OR "bio-oil") AND (clean OR wash)
 About 9,370 results (0.34 seconds)

absorption clay AND elution of solvent
 About 34,300 results (0.21 seconds)

clay column AND elution of solvent
 About 41,400 results (0.30 seconds)

Electronic Database Searched	Google Scholar
Files Searched	Google WebSite
Date Conducted	27 December 2018; 11-12 February 2019
Search Logic:	
pyrolysis oil About 713,000 results (0.27 seconds)	
pyrolysis oil AND adjust polarity About 16,600 results (0.27 seconds)	
pyrolysis oil AND adjust polarity AND (bind OR adsorb) About 18,900 results (0.32 seconds)	

("pyrolysis" OR "pyrolyzed") oil) AND adjust polarity AND (bind OR adsorb)
About 18,900 results (0.52 seconds)

("pyrolysis" OR "pyrolyzed") oil) AND adjust polarity with solvent AND (bind OR adsorb)
About 13,500 results (0.38 seconds)

("pyrolysis oil" OR "pyrolyzed oil") AND adjust polarity with solvent AND (bind OR adsorb)
About 364 results (0.37 seconds)

("pyrolysis oil" OR "pyrolyzed oil") AND adjust polarity with solvent AND (bind OR adsorb)
AND ((bind OR absorption) (contaminant OR unwanted))
About 82 results (0.55 seconds)

pyrolysis oil AND adjust polarity with solvent AND (bind OR adsorb) AND ((bind OR
absorption OR remove) (contaminant OR unwanted))
About 17,300 results (0.43 seconds)

pyrolysis oil AND adjust polarity with solvent AND (bind OR adsorb) AND ((bind OR
absorption OR remove) (contaminant OR unwanted)) clay
About 4,480 results (0.51 seconds)

pyrolysis oil AND adjust polarity with solvent AND (bind OR adsorb) AND ((bind OR
absorption OR remove) (contaminant OR unwanted)) clay AND (elution OR eluting)
About 1,190 results (0.53 seconds)

pyrolysis oil AND adjust polarity with solvent AND (bind OR adsorb) AND ((bind OR
absorption OR remove) (contaminant OR unwanted)) clay AND (elution OR eluting) AND
(separate solvent)
About 1,190 results (0.52 seconds)

pyrolysis oil AND adjust polarity with non-polar solvent AND (bind OR adsorb) AND ((bind OR
absorption OR remove) (contaminant OR unwanted)) clay AND (elution OR eluting) AND
(separate solvent)
About 411 results (0.53 seconds)

("pyrolysis oil" OR "pyrolyzed oil") AND (clean OR clarify)
About 9,030 results (0.19 seconds)

("pyrolysis oil" OR "pyrolyzed oil") AND (non-polar solvent OR butane OR pentane OR hexane
OR heptane)
About 1,040 results (0.34 seconds)

("pyrolysis oil" OR "pyrolyzed oil") AND (non-polar solvent OR butane OR pentane OR hexane
OR heptane) AND ((change OR modify OR reverse) polarity)
About 807 results (0.50 seconds)

("pyrolysis oil" OR "pyrolyzed oil") AND (non-polar solvent OR butane OR pentane OR hexane
OR heptane) AND ("change the polarity" OR "modify the polarity")

7 results (0.50 seconds)

("pyrolysis oil" OR "pyrolyzed oil") AND (non-polar solvent OR butane OR pentane OR hexane OR heptane) AND ("changing the polarity" OR "modifying the polarity")

3 results (0.50 seconds)

Your search - ("**pyrolysis oil**" OR "**pyrolyzed oil**") AND (non-polar solvent OR butane OR pentane OR hexane OR heptane) AND ("**polarity is changed**" OR "**polarity is changed**") - did not match any articles.

(biocrude OR bio-oil) AND ((change OR modify) polarity)

About 3,190 results (0.34 seconds)

(biocrude OR bio-oil) AND (non-polar solvent OR butane OR pentane OR hexane OR heptane) AND ("change the polarity" OR "modify the polarity")

10 results (0.50 seconds)

("pyrolysis oil" OR "pyrolyzed oil") AND (non-polar solvent OR butane OR pentane OR hexane OR heptane) AND ("changing the polarity" OR "modifying the polarity")

3 results (0.50 seconds)

("pyrolysis oil" OR "pyrolyzed oil" OR "biocrude" OR "bio-oil") AND ((non-polar solvent OR butane OR pentane OR hexane OR heptane) solvent)

About 2,500 results (0.35 seconds)

("pyrolysis oil" OR "pyrolyzed oil" OR "biocrude" OR "bio-oil") AND ((non-polar solvent OR butane OR pentane OR hexane OR heptane) solvent) AND evaporate solvent

About 1,200 results (0.50 seconds)

("pyrolysis oil" OR "pyrolyzed oil") AND ((non-polar solvent OR butane OR pentane OR hexane OR heptane) solvent) AND evaporate solvent

About 470 results (0.50 seconds)

clay AND elution of solvents AND pyrolysis oil

About 18,800 results (0.30 seconds)

clay AND elution of solvent AND ("pyrolysis oil" OR "bio-oil")

About 380 results (0.36 seconds)

(activated attapulgite OR palygorskite) AND clay AND elution of solvent AND ("pyrolysis oil" OR "bio-oil")

6 result (0.39 seconds)

(activated attapulgite OR palygorskite) AND clay AND solvent AND ("pyrolysis oil" OR "bio-oil")

About 109 results (0.36 seconds)

absorption of the contaminants onto clay AND elution of clean oil from solvent
 About 14,200 results (0.29 seconds)

absorption of the contaminants onto (clay OR activated attapulgite OR palygorskite) AND elution of clean oil from solvent
 About 1,230 results (0.43 seconds)

absorption of the contaminants onto (clay OR activated attapulgite OR palygorskite) AND solvent
 About 6,650 results (0.38 seconds)

absorption of the contaminants onto (clay OR activated attapulgite OR palygorskite) AND solvent AND ("pyrolysis oil" OR "bio-oil")
 About 72 results (0.55 seconds)

activate clay AND cleaning with acetone after cycle
 About 18,200 results (0.30 seconds)

(activate OR regenerate) by drying clay AND (clean OR wash) with acetone after cycle
 About 4,870 results (0.34 seconds)

(activate OR regenerate) by drying clay AND (clean OR wash) AND cycle
 About 21,900 results (0.41 seconds)

("pyrolysis oil" OR "bio-oil") AND (clean OR wash)
 About 17,400 results (0.34 seconds)

absorption clay AND elution of solvent
 About 26,800 results (0.21 seconds)

clay column AND elution of solvent
 About 35,500 results (0.30 seconds)

Supplemental

Electronic Database Searched	Google Patents
Date Conducted	12 February 2019

clay "pyrolysis oil" hexane
 About 85 results

clay "pyrolysis oil" hexane elute
 About 8 results

clay "pyrolysis oil" elute
 About 41 results