Kementerian Pendidikan, Kebudayaan, Riset dan Teknologi
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https://bima.kemdikbud.go.id

PROTEKSI ISI LAPORAN KEMAJUAN PENELITIAN TESIS MAGISTER

LAPORAN KEMAJUAN 2024

Rencana Pelaksanaan Penelitian Tesis Magister: tahun 2024 s.d. tahun 2024

1. JUDUL PENELITIAN

Analisis Karakteristik dan Kinerja Xathan Gum dengan Penambahan Porang untuk Peningkatan Perolehan Minyak Menuju Teknologi Ramah Lingkungan

Bidang Fokus	Tema	Topik (jika ada)	Prioritas Riset
Energi	Teknologi Ketahanan, Diversifikasi Energi dan Penguatan Komunitas Sosial	Teknologi pendukung EOR	Green Economy

Rumpun Ilmu Level 1	Rumpun Ilmu Level 2	Rumpun Ilmu Level 3
ILMU TEKNIK	TEKNOLOGI KEBUMIAN	Teknik Perminyakan (Perminyakan)

Skema Penelitian	Strata (Dasar/Terapan/ Pengembangan)	Nilai SBK	Target Akhir TKT	Lama Kegiatan
Penelitian Tesis Magister	Riset Dasar	35.000.000	3	1 Tahun

2. IDENTITAS PENGUSUL

Nama, Peran	Jenis	Program Studi/Bagian	Bidang Tugas	ID Sinta
MUHAMMAD TAUFIQ FATHADDIN 0315026702 Ketua Pengusul Universitas Trisakti	Dosen	Teknik Perminyakan	1. Koordinator Penelitian dan publikasi 2. Persiapan alat dan bahan 3. Uji viskositas 4. Uji water flooding 5. Uji polymer flooding 6. Pemodelan ANN 7. Pemodelan ANFIS 8. Publikasi 9. Overall review 10. Laporan Akhir	5973622
DWI ATTY MARDIANA 0325038104 Anggota Universitas Trisakti	Dosen	Teknik Perminyakan	1. Wakil koordinator penelitian 2. Persiapan alat dan bahan 3. Persiapan sandpack dan minyak 4. Persiapan brine dan larutan polimer 5. Uji Adsorpsi 4. Uji viskositas 5. Uji kompatibilitas 6. Publikasi 7. Overall review 8. Laporan Akhir	5973934
ANDRIAN SUTIADI 171012110004 Mahasiswa Bimbingan Universitas Trisakti	Mahasiswa	Teknik Perminyakan	1. Persiapan sandpack dan minyak 2. Persiapan brine dan larutan polimer 3. Uji Adsorpsi 4. Uji viskositas 5. Uji kompatibilitas 6. Uji water flooding 7. Uji polymer flooding 8. Pemodelan ANN 9. Pemodelan ANFIS	-

Nama, Peran	Jenis	Program Studi/Bagian	Bidang Tugas	ID Sinta
			10. Publikasi 11. Overall review 12. Laporan Akhir	

3. MITRA KERJASAMA PENELITIAN (Jika Ada)
Pelaksanaan penelitian dapat melibatkan mitra kerjasama yaitu mitra kerjasama dalam melaksanakan penelitian, mitra sebagai calon pengguna hasil penelitian, atau mitra investor

Mitra	Nama Mitra	Dana

4. LUARAN DAN TARGET CAPAIAN

Luaran Wajib

Tahun Luaran	Kategori Luaran	Jenis Luaran	Status target capaian	Keterangan
1	Artikel di Jurnal	Artikel di Jurnal Bereputasi Nasional Terindeks SINTA 1-4	Accepted/Published	https://journal.uir.ac.id/index.php/JEEE/issue

5. ANGGARAN
Rencana Anggaran Biaya penelitian mengacu pada PMK dan buku Panduan Penelitian dan Pengabdian kepada Masyarakat yang berlaku.

Total RAB 1 Tahun Rp33.560.000,00

Tahun 1 Total Rp33.560.000,00

Kelompok	Komponen	Item	Satuan	Vol.	Biaya Satuan	Total
Bahan	Bahan Penelitian (Habis Pakai)	Erlenmeyer 500 ml	Unit	6	110.000	660.000
Bahan	Bahan Penelitian (Habis Pakai)	Hot plate magnetic stirrer	Unit	1	2.000.000	2.000.000
Bahan	Bahan Penelitian (Habis Pakai)	Kertas Saring Whatmann	Unit	2	700.000	1.400.000
Bahan	Bahan Penelitian (Habis Pakai)	Timbangan digital	Unit	1	800.000	800.000
Bahan	Bahan Penelitian (Habis Pakai)	Beaker glass 1000 ml	Unit	3	95.000	285.000
Bahan	Bahan Penelitian (Habis Pakai)	Pasir 1 kg	Unit	1	20.000	20.000
Bahan	Bahan Penelitian (Habis Pakai)	Blender	Unit	1	918.000	918.000
Bahan	Bahan Penelitian (Habis Pakai)	Beaker glass 500 ml	Unit	6	95.000	570.000
Bahan	Bahan Penelitian (Habis Pakai)	Masker3200 respirator catridge3301N flter 3N11CN	Unit	3	120.000	360.000
Bahan	Bahan Penelitian (Habis Pakai)	NaCl	Unit	4	9.000	36.000
Bahan	Bahan Penelitian (Habis Pakai)	Cuvett spektrofotometer	Unit	1	540.000	540.000
Bahan	Bahan Penelitian	Gelas Ukur 250 ml	Unit	1	240.000	240.000

Kelompok	Komponen	Item	Satuan	Vol.	Biaya Satuan	Total
	(Habis Pakai)					
Bahan	Bahan Penelitian (Habis Pakai)	Beaker glass	Unit	6	95.000	570.000
Bahan	Bahan Penelitian (Habis Pakai)	Porang 500 gr	Unit	2	185.000	370.000
Bahan	Bahan Penelitian (Habis Pakai)	Gelas Ukur 10 ml	Unit	1	40.000	40.000
Bahan	Bahan Penelitian (Habis Pakai)	Laboratory schott duran bottle 500 ml	Unit	12	75.000	900.000
Bahan	ATK	Kertas 1 rim dan alat tulis	Paket	1	120.000	120.000
Pengumpulan Data	Transport	Transport peneliti	OK (kali)	3	300.000	900.000
Pengumpulan Data	HR Pembantu Peneliti	Peneliti Pembantu	OJ	4	50.000	200.000
Pengumpulan Data	Uang Harian	UH rapat dlm kantor Halfday meeting 3 orang	OH	3	200.000	600.000
Analisis Data	Biaya analisis sampel	Water fooding	Unit	2	500.000	1.000.000
Analisis Data	Biaya analisis sampel	Thermal stability	Unit	2	1.000.000	2.000.000
Analisis Data	Biaya analisis sampel	Polymer fooding	Unit	2	500.000	1.000.000
Analisis Data	Biaya analisis sampel	Uji viskositas	Unit	12	200.000	2.400.000
Analisis Data	Biaya analisis sampel	Uji kompatibilitas	Unit	12	200.000	2.400.000
Analisis Data	Biaya analisis sampel	Uji adsorpsi	Unit	12	400.000	4.800.000
Pelaporan Hasil Penelitian dan Luaran Wajib	Biaya pembuatan dokumen uji produk	Biaya pembuatan dokumen laporan dan jilid	Paket	1	500.000	500.000
Pelaporan Hasil Penelitian dan Luaran Wajib	Biaya Publikasi artikel di Jurnal Bereputasi Interasional	Proofreading dan Publikasi	Paket	1	1.000.000	1.000.000
Pelaporan Hasil Penelitian dan Luaran Wajib	Biaya Pendaftaran KI	Hak Cipta	Paket	1	200.000	200.000
Bahan	Bahan Penelitian (Habis Pakai)	Gelas Ukur 100 ml	Unit	1	140.000	140.000
Bahan	Bahan Penelitian (Habis Pakai)	Laboratory schott duran bottle 1000 ml	Unit	6	80.000	480.000
Bahan	ATK	Tinta printer Black & Colour	Paket	1	350.000	350.000
Bahan	Bahan Penelitian (Habis Pakai)	Erlenmeyer 1000 ml	Unit	3	110.000	330.000
Bahan	Bahan Penelitian (Habis Pakai)	Sandpack	Unit	3	1.000.000	3.000.000
Bahan	Bahan Penelitian	Xanthan gum	Unit	1	315.000	315.000

Kelompok	Komponen	Item	Satuan	Vol.	Biaya Satuan	Total
	(Habis Pakai)					
Bahan	Bahan Penelitian (Habis Pakai)	Erlenmeyer 250 ml	Unit	6	110.000	660.000
Bahan	Bahan Penelitian (Habis Pakai)	Pipet Ukur	Unit	8	22.000	176.000
Bahan	Bahan Penelitian (Habis Pakai)	Laboratory schott duran bottle 25 ml	Unit	24	45.000	1.080.000
Bahan	Bahan Penelitian (Habis Pakai)	Distilled Water	Unit	20	10.000	200.000

Pengisian poin C sampai dengan poin H mengikuti template berikut dan tidak dibatasi jumlah kata atau halaman namun disarankan seringkas mungkin. Dilarang menghapus/memodifikasi template ataupun menghapus penjelasan di setiap poin.

C. **HASIL PELAKSANAAN PENELITIAN:** Tuliskan secara ringkas hasil pelaksanaan penelitian yang telah dicapai sesuai tahun pelaksanaan penelitian. Penyajian meliputi data, hasil analisis, dan capaian luaran (wajib dan atau tambahan). Seluruh hasil atau capaian yang dilaporkan harus berkaitan dengan tahapan pelaksanaan penelitian sebagaimana direncanakan pada proposal. Penyajian data dapat berupa gambar, tabel, grafik, dan sejenisnya, serta analisis didukung dengan sumber pustaka primer yang relevan dan terkini.

Untuk mencapai tujuan peneltian seperti tercantum di dalam proposal yaitu menganalisis efek porang sebagai aditif terhadap kinerja xanthan gum dalam polymer flooding. Maka telah dilakukan penelitian laboratorium mulai 11 Juli hingga 25 September 2024 dan menghasilkan hasil penelitian yang meliputi hasil uji karakteristik larutan polimer, uji interaksi fluida dan batuan, serta uji perolehan minyak.

1. Pembuatan larutan xanthan gum dan porang

Beberapa konsentrasi larutan polimer dengan aditif dibuat dengan komposisi polimer xanthan gum, porang dan *brine* (air garam) ditunjukan pada Tabel 1. Dihasilkan sembilan sampel larutan dengan variasi konsentrasi polimer dan salinitas berbeda.

Tabel 1 Komposisi pembuatan larutan polimer xanthan gum dan porang

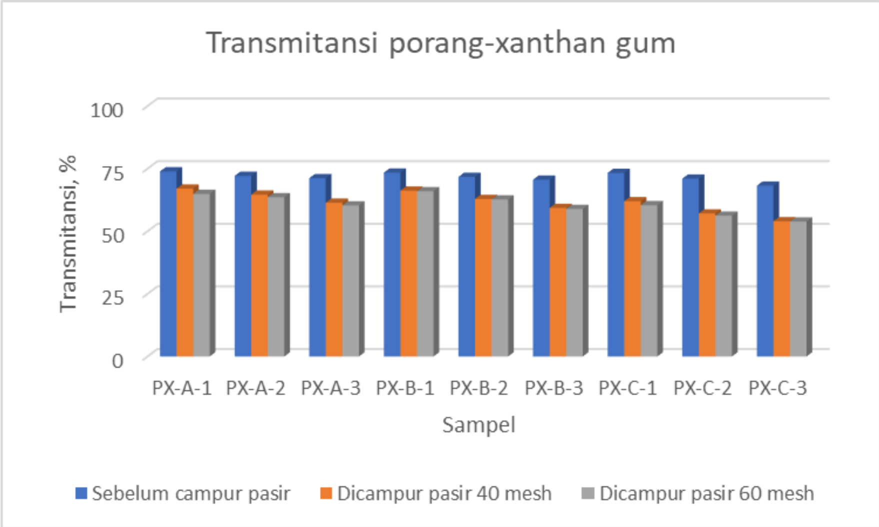
No.	Kode Sampel	Salinitas *brine* (ppm)	Konsentrasi Polimer (ppm)	Berat polimer porang (mg)	Berat polimer xanthan gum (mg)
1	PX-A-1	6000	2000	400	400
2	PX-A-2	6000	4000	800	800
3	PX-A-3	6000	6000	1200	1200
4	PX-B-1	12000	2000	400	400
5	PX-B-2	12000	4000	800	800
6	PX-B-3	12000	6000	1200	1200
7	PX-C-1	18000	2000	400	400
8	PX-C-2	18000	4000	800	800
9	PX-C-3	18000	6000	1200	1200

2. Uji karakteristik larutan

Uji karakteristik sembilan larutan polimer meliputi pengujian kompatibilitas dan uji viskositas.

a. Uji kompatibilitas

Hasil uji kompatibilitas sembilan larutan menggunakan alat uji transmitansi Spektofotometer pada Gambar 1 menunjukan bahwa nilai transmitansi dari seluruh larutan menghasilkan nilai lebih dari 50%, baik sebelum maupun sesudah dicampur dengan pasir ukuran 40 mesh dan 60 mesh, sehingga secara kuantitatif dapat dikatakan semua sampel larutan polimer porang-xanthan gum kompatibel untuk digunakan. Larutan dikatakan kompatibel jika tidak terdapat endapan atau gumpalan pada larutan [1] dan mempunyai nilai transmitansi > 50%, dimana transmitansi merupakan nilai yang menunjukan jumlah cahaya yang dapat diteruskan [2-3].



Gambar 1. Hasil uji transmitansi larutan polimer xanthan gum dan porang

Hasil penelitian menunjukan bahwa terjadi penurunan nilai transmitansi setelah larutan polimer porang-xanthan gum dicampur dengan pasir 40 mesh dan 60 mesh karena larutan menjadi lebih keruh, sehingga cahaya yang diteruskan berkurang. Selain itu, nilai transmitansi juga menurun seiring dengan meningkatnya konsentrasi polimer dan salinitas air formasi, karena larutan semakin pekat dan mengurangi cahaya yang diteruskan.

b. Uji viskositas

Hasil uji viskositas sembilan larutan pada Tabel 2 menunjukan bahwa viskositas larutan meningkat berbanding lurus dengan kenaikan konsentrasi larutan polimer. Semakin tinggi konsentrasi berarti terdapat peningkatan jumlah zat di dalam larutan yang akan menambah beban pada larutan dan gesekan antar partikel akan semakin banyak sehingga viskositas meningkat. Peningkatan viskositas fluida injeksi, polimer dapat menaikan *sweep efficiency* sehingga meningkatkan perolehan minyak [4]. Viskositas larutan polimer xanthan gum – porang pada konsentrasi 6000 ppm dalam tiga variasi salinitas mengalami peningkatan 26 - 27,7 kali dibanding viskositas larutan polimer xanthan gum – porang konsentrasi 2000 ppm.

Hasil penelitian juga menunjukan bahwa nilai viskositas mengalami penurunan terhadap kenaikan salinitas. Penambahan kadar NaCl akan memperpendek rantai polimer sehingga viskositas menurun. Hasil pada Tabel 2 memperlihatkan bahwa viskositas larutan polimer xanthan gum – porang pada tiga variasi konsentrasi dengan salinitas 6000 ppm mengalami penurunan sebanyak 73-77% saat salinitas larutan ditingkatkan hingga 18000 ppm. Larutan polimer xanthan gum – porang konsentrasi 6000 ppm pada salinitas 6000 ppm (sampel PX-A-3) merupakan larutan yang menghasilkan nilai viskositas tertinggi yaitu 284,72 cP.

Tabel 2. Hasil uji viskositas larutan polimer xanthan gum dan porang

No	Konsentrasi polimer (ppm)	Salinitas (ppm)	Kode sampel	Viskositas (cP)
1	2000	6000	PX-A-1	10,28
2	4000		PX-A-2	77,04
3	6000		PX-A-3	284,72
4	2000	12000	PX-B-1	9,85
5	4000		PX-B-2	68,77
6	6000		PX-B-3	263,38
7	2000	18000	PX-C-1	7,96
8	4000		PX-C-2	58,10
9	6000		PX-C-3	207,10

c. Uji adsorpsi

Perilaku larutan polimer pada media berpori salah satunya adalah adanya efek adsorpsi yaitu efek penyerapan dari zat-zat di dalam fluida oleh permukaan padatan yang dapat merubah komposisi fluida tersebut menjadi komposisi lain yang terjadi di pori batuan [5]. Adsorption dipengaruhi oleh jenis polimer yang digunakan, komposisi batuan, salinitas, kadar kekerasan batuan, suhu, konsentrasi dari polimer [6]. Salinitas mempengaruhi adsorpsi melalui viskositas. Dimana semakin encer larutan maka akan semakin mudah solute untuk teradsorp ke dalam pori [7]. Semakin tinggi konsentrasi maka akan semakin banyak jumlah solute atau zat terlarut dalam suatu larutan, semakin banyak jumlah zat terlarut maka akan semakin banyak partikel yang teradsorp [8]. Dan semakin kecil ukuran butir pasir maka akan semakin banyak ruang pori yang ada, maka akan semakin luas permukaan adsorben yang menyerap zat terlarut, sehingga adsorpsi akan semakin tinggi [9-10].

Uji adsorpsi larutan polimer menggunakan alat spectrofotmetri FTIR pada masing-masing konsentrasi dan variasi salinitas dilakukan melalui pembacaan untuk melihat nilai serapan dari setiap konsentrasi larutan polimer, ditampilkan pada Tabel 3. Pasir berukuran 40 dan 60 mesh sebanyak 40 gram digunakan sebagai media adsorben. Untuk menentukan hubungan antara absorbansi dan konsentrasi, kurva standar atau kurva kalibrasi dibuat sebagai langkah awal dalam menghitung konsentrasi untuk setiap sampel (Fathaddin, 2006; Fathaddin dan Awang, 2004). Jumlah total polimer yang teradsorpsi akan dihitung dari percobaan batch menggunakan hubungan berikut yang dihasilkan dari neraca massa sebagai berikut [11]:

$$Q_e = \frac{(C_{in} - C_{out})}{m} V$$

Nilai adsorpsi (Q_e) diperoleh dari rasio berat larutan polimer dan padatan (V/m) dengan selisih konsentrasi larutan polimer awal (C_{in}) dan akhir (C_{out}). Dimana selisih nilai konsentrasi larutan polimer awal sebelum proses adsorpsi (C_{in}) dan konsentrasi larutan polimer akhir setelah proses adsorpsi (C_{out}) merupakan jumlah adsorpsi pada kondisi setimbang.

Tabel 3. Hasil adsorpsi larutan polimer xanthan gum dan porang

No.	Kode sampel	Salinitas (ppm)	Konsentrasi awal (ppm)	Konsentrasi akhir (ppm)		Adsorpsi (mg/g)	
				Setelah 40 mesh	Setelah 60 mesh	Setelah 40 mesh	Setelah 60 mesh
1	PX-A-1	6000	2000	1385,4	479,6	1,536	3,801
2	PX-A-2	6000	4000	3055,1	1953,8	2,362	5,115
3	PX-A-3	6000	6000	4760,2	3552,4	3,099	6,119
4	PX-B-1	12000	2000	1221,6	208,7	1,946	4,478
5	PX-B-2	12000	4000	2860,7	1718,8	2,848	5,703
6	PX-B-3	12000	6000	4518,1	3376,3	3,705	6,559
7	PX-C-1	18000	2000	1071,7	174,5	2,321	4,564
8	PX-C-2	18000	4000	2735,2	1613,7	3,162	5,966
9	PX-C-3	18000	6000	4360,4	3034,3	4,097	7,414

Hasil penelitian pada Tabel 3 menunjukkan beberapa faktor yang mempengaruhi peningkatan nilai adsorpsi larutan. Pertama, peningkatan konsentrasi larutan polimer porang-xanthan gum meningkatkan adsorpsi karena lebih banyak zat dalam larutan yang terserap ke pori batuan. Kedua, kenaikan salinitas menurunkan viskositas larutan yang memudahkan aliran dan penyerapan ke pori batuan, sehingga meningkatkan adsorpsi. Ketiga, perubahan ukuran butir pasir; semakin kecil ukuran butir, semakin tinggi nilai adsorpsi karena luas permukaan yang lebih besar untuk menyerap larutan. Moradi [5] menyebutkan bahwa larutan polimer stabil memiliki nilai adsorpsi yang kecil karena tidak terpengaruh oleh serapan yang terjadi di permukaan batuan.

3. Pemilihan larutan

Hasil uji kompatibilitas menunjukan bahwa penambahan konsentrasi larutan polimer dan salinitas air formasi menurunkan nilai transmitansi, namun seluruh sampel larutan kompatibel ditunjukan dengan tidak adanya endapan dan nilai transmitansi lebih dari 50%. Hasil uji adsorpsi menunjukan bahwa nilai adsorpsi larutan dipengaruhi oleh peningkatan konsentrasi, salinitas, dan ukuran batuan. Uji viskositas mengindikasikan bahwa larutan polimer xanthan gum – porang pada konsentrasi 6000 ppm dan salinitas 6000 ppm (sampel PX-A-3) menghasilkan nilai viskositas tertinggi yaitu 284,72 cP merupakan larutan terpilih untuk digunakan pada uji perolehan minyak.

4. **Uji perolehan minyak**

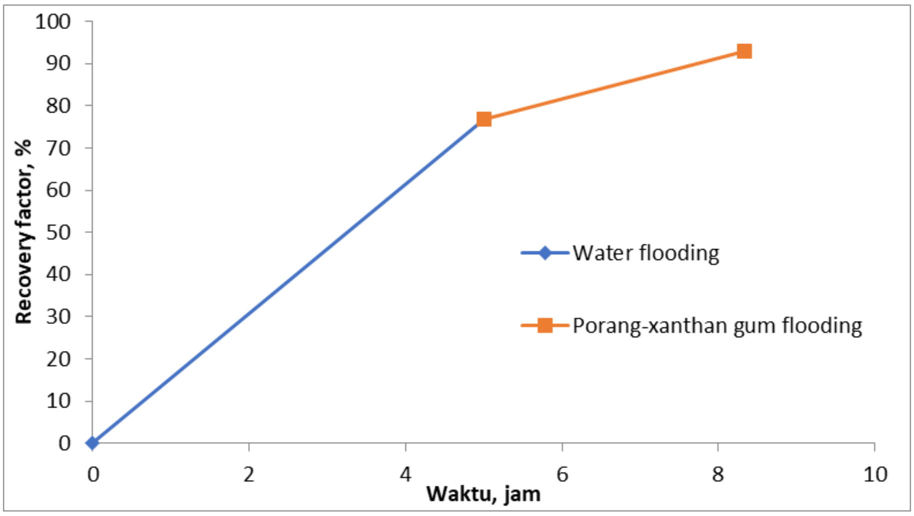
Setelah uji kompatibilitas dan karakteristik larutan dilakukan untuk mendapatkan larutan injeksi yang optimal, uji perolehan minyak dilakukan untuk menguji stabilitas larutan polimer terpilih ketika melewati batuan berpori, dalam penelitian ini menggunakan *sandpack* yang berasal dari pasir silika homogen berukuran 60 mesh. Nilai porositas dari *sandpack* yaitu sebesar 61,7%. Nilai ini tergolong tinggi disebabkan karena pasir yang mengisi *sandpack* merupakan pasir yang homogen tanpa adanya semen, sehingga memungkinkan banyak ruang pori pada *sandpack*.

Uji *sandpack flooding* dilakukan bertahap dengan injeksi larutan polimer (polymer flooding) setelah tahap injeksi air (*waterflooding*) selesai dilakukan. Tahap pertama yaitu mengisi batuan (*sandpack*) dengan brine hingga saturasi air dalam batuan 100% (S_w = 100%), pada penelitian ini, total volume injeksi brine sebanyak 50 mL dan brine yang keluar dari *sandpack* sebanyak 34,8 mL, sehingga diperoleh *pore volume sandpack* sebesar 15,2 mL. Tahap kedua adalah mengisi minyak ke dalam *sandpack* untuk mengetahui volume awal minyak dengan menginjeksikan minyak pada *core* hingga air tidak keluar lagi. Sebanyak 20 mL minyak diinjeksikan pada *sandpack* untuk mendorong brine keluar dari *sandpack* sehingga minyak akan masuk mengisi ruang pori-pori *sandpack*. Volume brine yang keluar sebanyak 11 mL dan minyak yang keluar sebesar 8,8 mL. Selisih antara total injeksi volume minyak terhadap volume minyak yang keluar disebut sebagai volume awal perolehan untuk mengetahui *saturasi oil residual* (S_{or}). Dengan volume sebesar 11,2 mL maka nilai *saturasi oil residual* sebesar 73,7% (S_{or} = 73,7%). Tahap ketiga ada proses *waterflooding* dengan menginjeksikan brine kedalam *sandpack* sehingga diperoleh *recovery oil* dari fasa *secondary recovery*. Brine yang diinjeksi sebanyak 30 mL dan jumlah minyak yang terdorong keluar sebanyak 8,6 mL. Minyak yang keluar ini merupakan perolehan minyak dari proses *waterflooding*. Tahap keempat adalah proses *tertiary recovery* dengan menginjeksikan larutan polimer xanthan gum – porang konsentrasi 6000 ppm dan salinitas 6000 ppm (sampel PX-A-3) pada *sandpack* sehingga didapat tambahan perolehan minyak yang tersisa dari *sandpack* tersebut. Larutan polimer sampel PX-A-3 sebanyak 20 mL diinjeksikan ke dalam *sandpack* hingga mampu mengeluarkan 1,8 mL minyak dari *sandpack*. Minyak yang keluar ini merupakan perolehan minyak dari proses polymer flooding.

Tabel 4. Hasil perolehan *sandpack flooding* menggunakan polimer porang-xanthan gum

Waktu (Jam)	Perolehan minyak (mL)	*Recovery Factor* (%)	*Incremental* (%)
0	0	0	0
5,00	8,6	76,79	0
8,33	10,4	92,86	16,07

Tabel 4 menunjukkan hasil perolehan minyak dari proses *water flooding* dan *polymer flooding* dan Gambar 2 menunjukan grafik peningkatan presentase *recovery factor* dari tahapan injeksi. Injeksi larutan polimer xanthan gum – porang mampu meningkatkan perolehan minyak sebanyak 16.07%. Hasil penelitian ini selaras dengan teori dan penelitian sebelumnya bahwa injeksi polimer dapat meningkatkan perolehan minyak dikarenakan terjadinya peningkatan nilai viskositas fluida pendesak untuk menaikan *sweep efficiency* [4, 12-15].



Gambar 2. Recovery factor dari waterflooding dan polymer flooding

D. **STATUS LUARAN**: Tuliskan jenis, identitas dan status ketercapaian setiap luaran wajib dan luaran tambahan (jika ada) yang dijanjikan. Jenis luaran dapat berupa publikasi, perolehan kekayaan intelektual, atau luaran lainnya yang telah dijanjikan pada proposal. Uraian status luaran harus didukung dengan bukti kemajuan ketercapaian luaran sesuai dengan luaran yang dijanjikan. Lengkapi isian jenis luaran yang dijanjikan serta mengunggah bukti dokumen ketercapaian luaran melalui BIMA.

Luaran penelitian yang ditargetkan adalah publikasi ilmiah yang disubmit pada jurnal nasional terakreditasi Sinta 3, dengan daftar sebagai berikut.

Jenis luaran	Identitas	Status
Luaran wajib: Jurnal nasional terakreditasi Sinta 3	Judul: Characterization of porang and xanthan gum solutions for polymer flooding Jurnal: Journal of Earth Energy Engineering Website: http://journal.uir.ac.id/index.php/JEEE/index Penerbit: Universitas Islam Riau (UIR) Press	Submitted
Luaran tambahan: Jurnal internasional bereputasi	Judul: Dataset on the characterization of shrimp and crab chitosans, Mesona palustris BL, Cyclea barbata Miers, and seaweed as natural polymers Jurnal: Data in Brief Website: https://www.sciencedirect.com/journal/data-in-brief	Review kedua (setelah revisi)

E. **PERAN MITRA:** Tuliskan realisasi kerjasama dan kontribusi Mitra baik *in-kind* maupun *in-cash* serta mengunggah bukti dokumen pendukung sesuai dengan kondisi yang sebenarnya. Bukti dokumen realisasi kerjasama dengan Mitra dapat diunggah melalui BIMA.

Catatan:
Bagian ini wajib diisi untuk penelitian terapan, untuk penelitian dasar (Fundamental, Pascasarjana, PKDN, Dosen Pemula) boleh mengisi bagian ini (tidak wajib) jika melibatkan mitra dalam pelaksanaan penelitiannya

Tidak ada mitra dalam penelitian ini.

F. **KENDALA PELAKSANAAN PENELITIAN**: Tuliskan kesulitan atau hambatan yang dihadapi selama melakukan penelitian dan mencapai luaran yang dijanjikan, termasuk penjelasan jika pelaksanaan penelitian dan luaran penelitian tidak sesuai dengan yang direncanakan atau dijanjikan.

Tidak ada kendala dalam penelitian dan luaran sesuai dengan yang direncanakan.

G. RENCANA TAHAPAN SELANJUTNYA: Tuliskan dan uraikan rencana penelitian selanjutnya berdasarkan indikator luaran yang telah dicapai, rencana realisasi luaran wajib yang dijanjikan dan tambahan (jika ada) di tahun berikutnya serta *roadmap* penelitian keseluruhan. Pada bagian ini diperbolehkan untuk melengkapi penjelasan dari setiap tahapan dalam metoda yang akan direncanakan termasuk jadwal berkaitan dengan strategi untuk mencapai luaran seperti yang telah dijanjikan dalam proposal. Jika diperlukan, penjelasan dapat juga dilengkapi dengan gambar, tabel, diagram, serta pustaka yang relevan. Jika laporan kemajuan merupakan laporan pelaksanaan tahun terakhir, pada bagian ini dapat dituliskan rencana penyelesaian target yang belum tercapai.

Pelaksanaan penelitian telah sampai pada tahap uji analisis perolehan minyak. Tahap berikutnya adalah pemodelan dan simulasi menggunakan Artificial Neural Network (ANN) dan Adaptive Neuro Fuzzy Inference System (ANFIS) yang akan berlangsung pada 30 September 2023. Penelitian diupayakan akan selesai pada akhir Oktober 2023, dengan rincian kegiatan sebagai berikut:

Tahap	Kegiatan	Capaian	Status
1	Persiapan sampel a. Pembuatan sandpack b. Pembuatan air formasi sintetis (brine) dengan variasi salinitas 6000 ppm, 12000 ppm, 18000 ppm c. Penyiapan sampel minyak d. Pembuatan larutan polimer dengan variasi konsentrasi 2000 ppm, 4000 ppm, 6000 ppm	a. Sandpack, 100% selesai b. Brine, 100% selesai c. Sembilan larutan polimer, selesai 100%	Persiapan sampel selesai sesuai dengan rencana kerja proposal.
2	Uji karakterisasi larutan polimer a. Uji kompatibilitas (transmitansi) b. Uji viskositas	a. Uji kompatibilitas larutan, selesai 100% b. Uji viskositas larutan, selesai 100%	Uji tahap 1 selesai sesuai dengan rencana kerja proposal.
3	Analisis interaksi fluida-batuan a. Uji adsorpsi	a. Uji adsorpsi, selesai 100%	Uji tahap 2 selesai sesuai dengan rencana kerja proposal.
4	Analisis perolehan minyak	Uji waterflooding dan polymer flooding selesai 100%	Uji tahap 3 selesai sesuai dengan rencana kerja proposal.
5	Pemodelan dan simulasi a. Artificial neural network (ANN) b. Adaptive neuro fuzzy inference system (ANFIS)	Pemodelan dan simulasi direncanakan selesai pada akhir Sept 2024	Hasil analisis pemodelan dan simulasi akan diselesaikan paling lambat pada akhir Oktober 2024

H. DAFTAR PUSTAKA: Penyusunan Daftar Pustaka berdasarkan sistem nomor sesuai dengan urutan pengutipan. Hanya pustaka yang disitasi pada laporan kemajuan yang dicantumkan dalam Daftar Pustaka.

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[JEEE] Submission Acknowledgement

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Journal of Earth Energy Engineering

Publisher: Universitas Islam Riau (UIR) Press

Characterization of porang and xanthan gum solutions for polymer flooding

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Article History:

Received: Month Date, Year
Receive in Revised Form: Month Date, Year
Accepted: Month Date, Year

Keywords:

Polymer flooding, recovery factor, oil displacement, Xanthan gum, porang.

Abstract

Porang tubers contain glucomannan which is used in various industries. Porang is a biopolymer that has the potential to be applied in polymer flooding in oil reservoirs. In this research, a combination of porang and Xanthan gum was used for displacing oil in the laboratory. The samples analyzed varied with polymer concentrations of 2000, 4000, and 6000 ppm respectively for porang solution, Xanthan gum, and a mixture of porang and Xanthan gum. The salinity of the formation water used in this research was 6000, 12000 and 18000 ppm. The experiment aimed to observe the characteristics and performance of porang and Xanthan gum including testing for compatibility, viscosity, adsorption and sandpack flooding. Based on the test results, all samples were compatible. The application of a mixture of porang and Xanthan gum provided lower adsorption compared to the application of only Xanthan gum. The highest reduction in adsorption value given was 1.007 mg/gr. The highest viscosity and additional recovery factor were given by a mixture of porang and Xanthan gum with a concentration of 6,000 ppm and a salinity of 18,000 ppm, namely 284.72 cP and 16.1%, respectively.

INTRODUCTION

The EOR method can change the properties of rock and reservoir fluids such as viscosity, mobility ratio of oil and water, interfacial tension and wettability. There are several types of EOR methods which are differentiated based on the type of material used in the injection, namely thermal injection (steam flood and hot water), miscible gas injection (CO2, N2, hydrocarbon gas, natural gas mixture), chemical injection (polymers, surfactants, alkalis), and microbial EOR (Green and Willhite, 2018).

The enhanced oil recovery (EOR) method which uses chemical injection is a technique to increase petroleum production by adding chemicals to the injected water. This is done to increase sweep efficiency and reduce oil saturation in the reservoir so that oil recovery can increase. There are three types of chemicals that are generally used in chemical injections, namely polymers, surfactants and alkalis (Ansyori, 2018). One type of chemical EOR that is widely used is polymer injection (Putra & Kiono, 2021; Fathaddin, et al., 2024).

Polymer injection plays a role in increasing the mobility ratio so that it does not cause fingering and increases sweep efficiency (Zhang et al., 2018; Abirov & Eremin, 2019). Polymers that can be applied in the EOR method must have certain characteristics, including being soluble in water, having high viscosity at low concentrations, having thermal resistance, having mechanical stability, and also good salinity (Arina & Kasmungin, 2016). Increasing the viscosity of the injection fluid to the oil, causes the sweep efficiency of the

DOI: 10.25299/jeee.year.volx(y).xxxx
eISSN: 2540-9352 pISSN: 2301-8097

polymer injection to increase. So, oil recovery can be increased (Agi et al., 2018; Chen et al., 2020; Chen et al., 2021).

In the oil and gas industry, three types of polymers have been developed. The types of polymers are synthetic polymers such as hydrolized polyacrylamides (HPAM), secondly organic polymers or often called biopolymers in the form of polysaccharides such as xanthan gum, and the third type of polymer is hydrophobically associated polymers (Saleh et al., 2017). Apart from xanthan gum, organic polymers also have the potential to be used in polymer injection to increase sweep efficiency, including chitosan polymer, seaweed, green grass jelly leaves (Cyclea barbata Miers), and black grass jelly (Mesonapalustris). Chitosan can be made from shrimp shells and crab shells (Fathaddin et al., 2024). Green grass jelly, seaweed, cotton leaves and shrimp shells contain hydrocolloids which are polymer components derived from plants, animals, microbes or synthetic components which generally contain hydroxyl (Herawati, 2018).

One of the hydrocolloids that has the potential to become a biopolymer is porang (Amorphohallus oncophyllus). Porang is a plant that has great potential as a source of glucomannan. Glucomannan is used as a thickener, gel former, texture improver, water binder, stabilizer and emulsifier (Yanuriati et al., 2017). This research was based on previous research which used biopolymers containing hydrocolloids to improve the quality of the polymer which was used as a reference and background for this research. In this study, a mixture of porang and xanthan gum was used to compare the quality of the two polymers. The focus of this research is to determine the characteristics of adding porang to the xanthan gum solution.

MATERIAL AND METHOD

The tools used were magnetic stirrer, digital scales, dropper pipettes, bottles, chemical glasses, stopwatch, Ostwald viscometer, UV visible spectrophotometer, and sandpack flooding. While, the materials used were distilled water, 40 and 60 mesh sand grains, natrium chloride (NaCl), Xanthan gum, and porang.

The preparation of tool and material was the first step in the research process. Subsequently, solutions were prepared with salinities of 6000 ppm, 12000 ppm, and 18000 ppm. Polymer solutions containing 2000 ppm, 4000 ppm, and 6000 ppm of polymer were then produced. Compatibility testing was done after the polymer solutions were made. The solution was rejected if it was incompatible because of turbidity or sediment formation. Conversely, if the polymer solution was compatible, proceed with the viscosity and static adsorption tests. Transmittance tests and visual inspection were both used to assess the compatibility of the solutions.

Meanwhile, the static adsorption test of polymer on sand used sand grains with sizes of 40 mesh and 60 mesh. Transmittance and absorption were measured using UV Vis Spectrophotometer. While viscosity was measured using Ostwald viscometer. The sandpack used acrylic material, made with dimensions of 11.8 cm × 2.7 cm × 0.76 cm. The research procedure is depicted schematically in Figure 1 (Siahaya et al., 2023).

RESULTS AND DISCUSSION

In this section, the characteristics of the experimental results of porang polymer, Xanthan gum, and porang-Xanthan gum are discussed. The discussion includes the results of testing for compatibility, viscosity, adsorption, and sandpack flooding injection.

The compatibility test is an assessment that states whether or not the polymer solution previously used is compatible (Yasahardja et al., 2017). Compatibility testing is carried out with the aim of assessing whether the polymer dissolves completely in formation water in various concentrations and salinities. The solution that has previously been stirred and mixed thoroughly is put into the bottle to observe whether it has dissolved completely and no precipitate has formed. Then, the transmittance of each solution was measured using a spectrophotometer. From the tests that have been carried out, all porang and xanthan gum polymer solutions dissolve completely and no precipitate is formed, and the transmittance value of each solution is above 50% both before and after being mixed with 40 and 60 mesh sand.

Figures 2 to 4 show the transmittance measurement results of various solutions of porang, Xanthan gum, and mixtures of porang and Xanthan gum for various concentrations and salinities. In general, all samples produced transmittance values of more than 50% both in initial conditions and after adsorption occurred due to interaction with sand.

Figure 2 shows that the transmittance of the porang solution varies between 63.4% to 90.6%. The transmittance value decreased due to increasing concentration and the adsorption process. The adsorption process was carried out by pouring polymer on sand grains. The adsorption process caused a decrease in concentration as a result of some of the polymer molecules being adsorbed on the sand surface. A decrease in polymer concentration should lead to an increase in transmittance because the concentration of the solution was reduced. The decrease in transmittance was caused by increasing turbidity due to fine grains of sand floating in the polymer solution. This was reinforced by the transmittance value of the porang

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solution after the adsorption process with sand grains of a finer size (60 mesh) which is lower than the transmittance value of the porang solution after adsorption with sand grains of a larger size (40 mesh). Figure 2 also shows a decrease in the transmittance value with increasing salinity of the porang solution. This is because the turbidity of the polymer solution increases with increasing salinity, so that the amount of light transmitted during transmittance measurements will decrease.

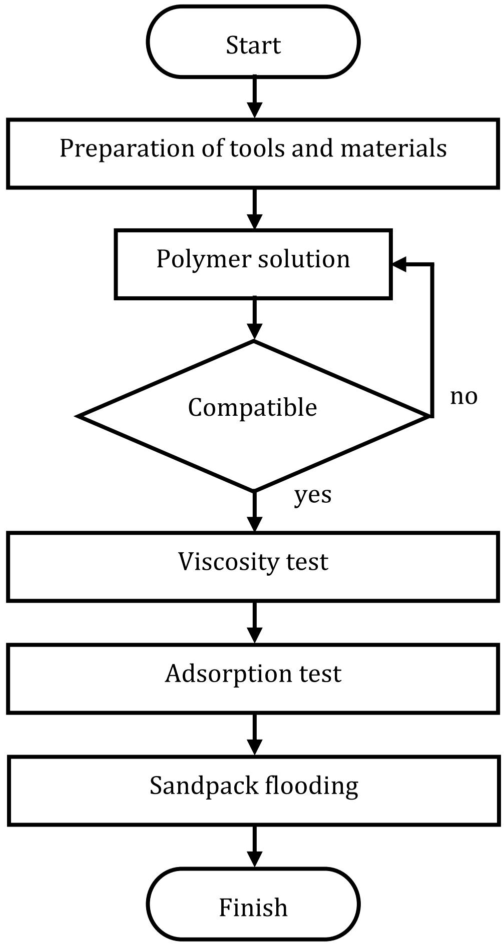


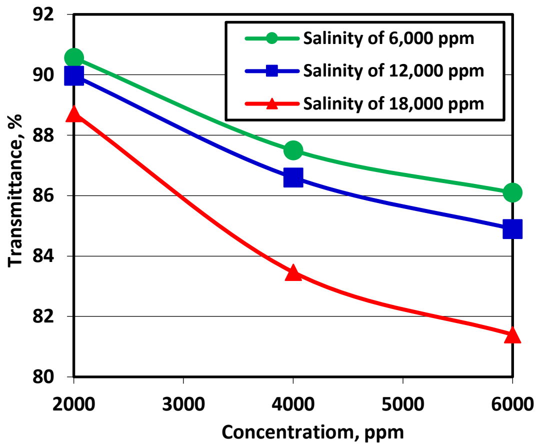
Figure 1. Research Procedure.

Figure 3 shows the transmittance measurement of the Xanthan gum solution. The transmittance values vary between 67.9% to 88.5%. In general, the influence of concentration, adsorption, and salinity on the transmittance of the Xanthan gum solution is directly proportional to their influence on the transmittance of the porang solution. However, the effect of salinity on changes in the transmittance of the Xanthan gum solution is smaller than the effect on the porang solution.

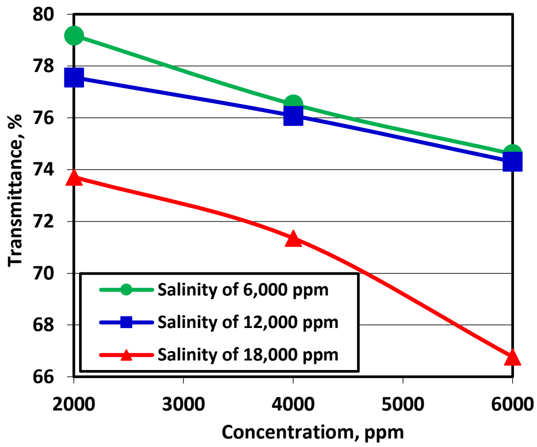
Figure 4 shows the transmittance measurement of porang and Xanthan gum mixture solution. The transmittance of the solution varied between 55.4% to 75.5%. The effect of salinity on changes in the transmittance of porang and Xanthan gum mixture solution as well as Xanthan gum solution is smaller than the effect of the porang solution.

Figures 2 to 4 show a comparison of the transmittance measurement results for porang solution, Xanthan gum, and a mixture of porang and Xanthan gum. In the initial conditions, the porang solution had a transmittance value of the porang solution that was higher than the transmittance value of the Xanthan gum solution and the mixed solution of porang and Xanthan gum. Meanwhile, the smallest influence of salinity and adsorption on transmittance was in the Xanthan gum solution. However, since the transmittance is more than 50% of light and no precipitation occurs, it can be said that all porang polymer solution samples are compatible for use.

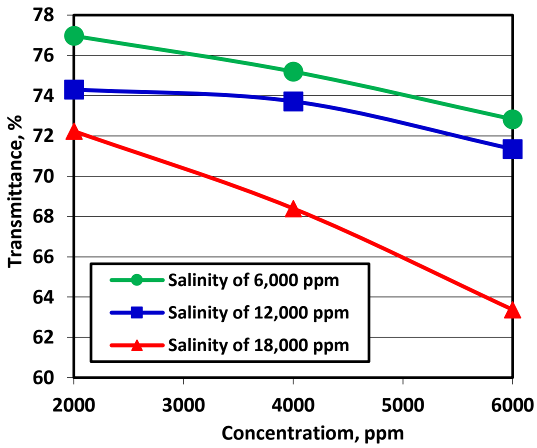
Figures 5 to 7 show the results of measuring the density of solutions of porang, Xanthan gum, and a mixture of porang and Xanthan gum. The density of polymer pollution is influenced by its components, namely distilled water, NaCl, porang, and Xanthan gum. The densities of distilled water, NaCl, porang, and Xanthan gum are 0.997 g/cc, 2.16 g/cc, 0.63 gr/cc, and 1.5 g/cc respectively at 25 ºC (Kirshenbaum et al., 1962; Win, 2021; Mukkun et al., 2022; Jiang et al., 2022; Xanthan gum, 2024).



A. at initial condition

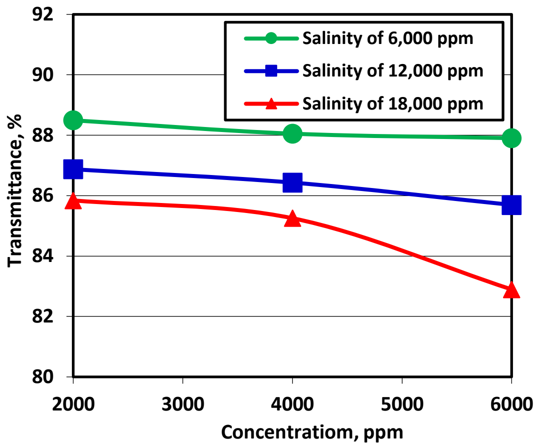


B. After adsorption with 40 mesh sand grains

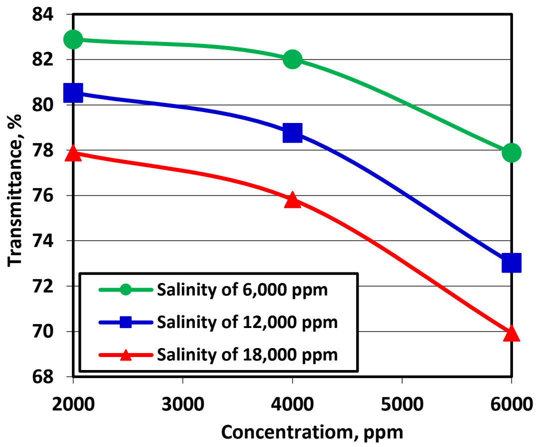


C. After adsorption with 60 mesh sand grains

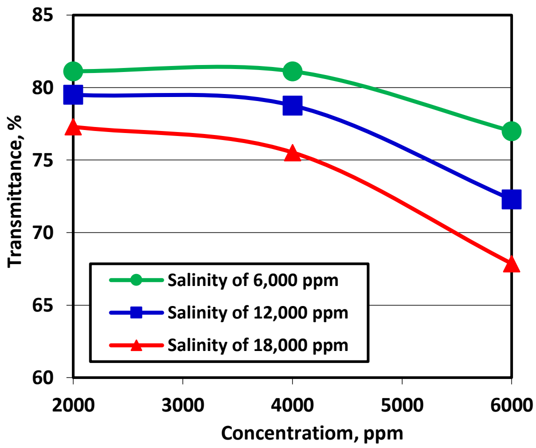
Figure 2. Results of transmittance measurements of porang solution before and after adsorption for various salinities.



A. at initial condition



B. After adsorption with 40 mesh sand grains



C. After adsorption with 60 mesh sand grains

Figure 3. Results of transmittance measurements of Xanthan gum solution before and after adsorption for various salinities.

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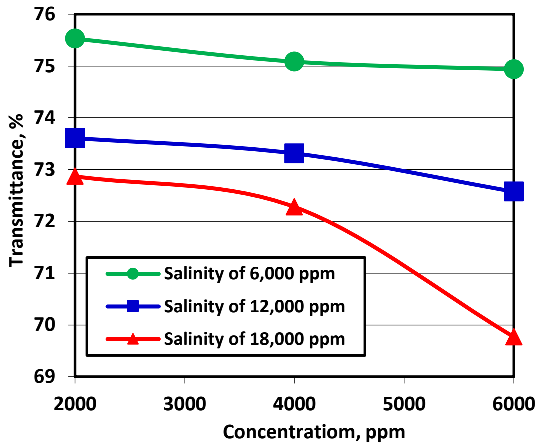
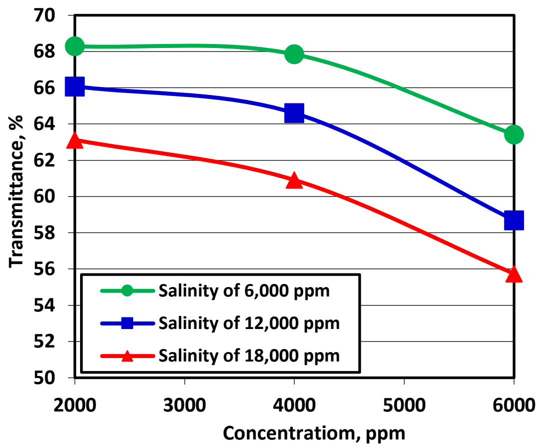
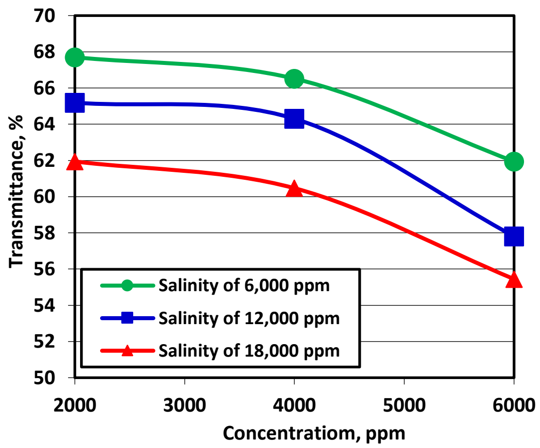


A. at initial condition

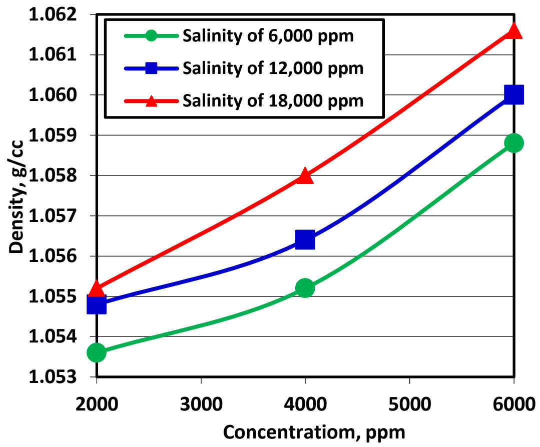


B. After adsorption with 40 mesh sand grains

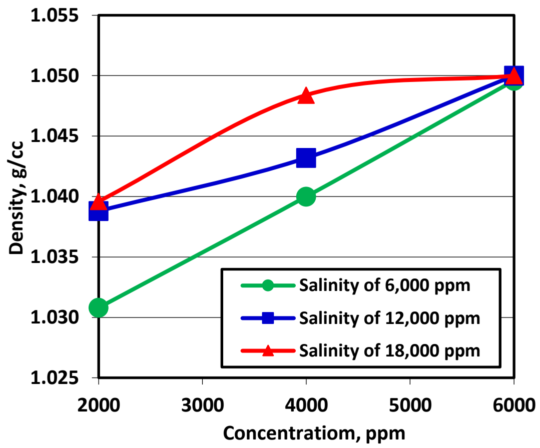


C. After adsorption with 60 mesh sand grains

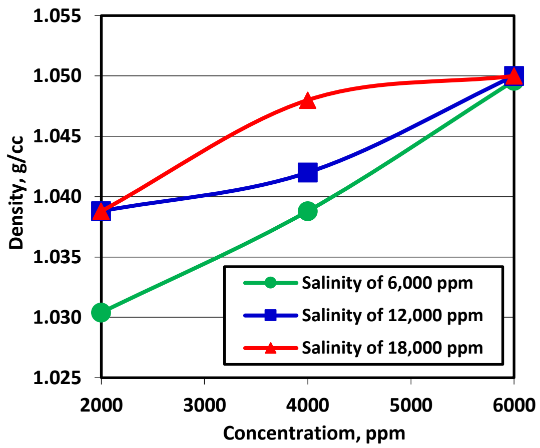
Figure 4. Results of transmittance measurements of porang-Xanthan gum mixture solution before and after adsorption for various salinities.



A. at initial condition

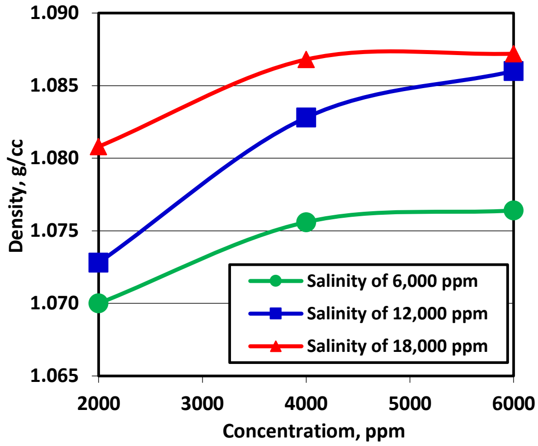


B. After adsorption with 40 mesh sand grains

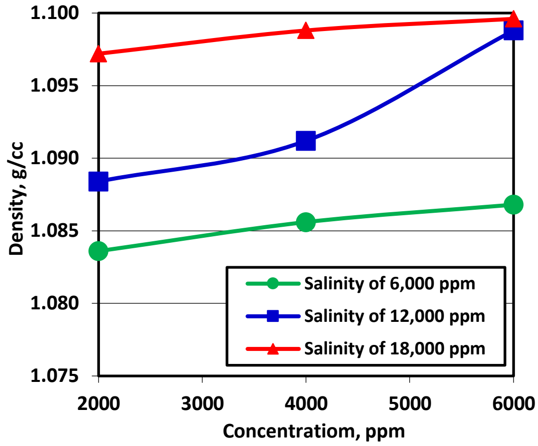


C. After adsorption with 60 mesh sand grains

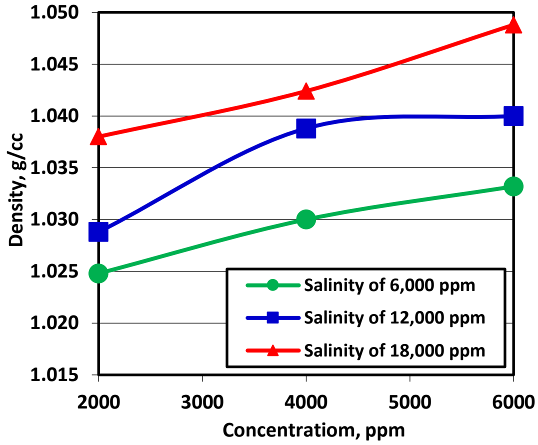
Figure 5. Results of density measurements of porang solution before and after adsorption for various salinities.



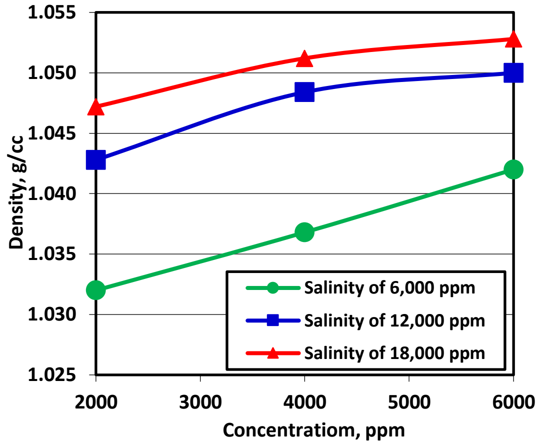
A. at initial condition



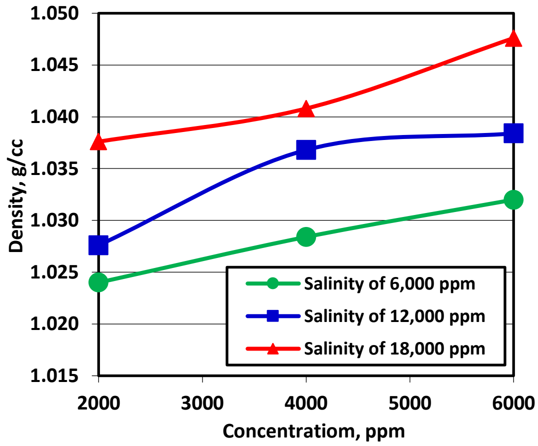
A. at initial condition



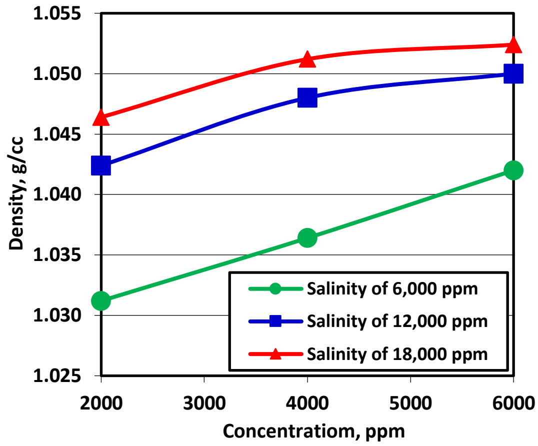
B. After adsorption with 40 mesh sand grains



B. After adsorption with 40 mesh sand grains



C. After adsorption with 60 mesh sand grains



C. After adsorption with 60 mesh sand grains

Figure 6. Results of density measurements of Xanthan gum solution before and after adsorption for various salinities.

Figure 7. Results of density measurements of porang-Xanthan gum mixture solution before and after adsorption for various salinities.

Figure 5 shows that the density of the porang solution varies between 1.0304 to 1.0616 g/cc. Density tends to increase with increasing concentration and salinity. On the other hand, the density of the porang solution decreases due to adsorption. The interaction and binding of dissolved solid molecules on the sand surface results in a reduction in the concentration of dissolved substances and a decrease in the density of the solution. Figures 5b and 5c show that the density tends to decrease with decreasing sand grain size from 40 mesh to 60 mesh. A pile of sand with a smaller grain size has a larger surface area for the same weight. So that a smaller sand grain size causes a higher adsorption level.

Figures 8 to 10 show the viscosity of porang, Xanthan gum, and a mixture of porang and Xanthan gum solutions for various concentrations and salinities before and after adsorption. Figures 8 to 10 show that increasing salinity causes a decrease in viscosity values. The viscosity of the porang solution at initial conditions is shown in Figure 8a. The decrease in viscosity from 6000 ppm to 18000 ppm salinity varies from 20.1% to 31.2%. The viscosity of the Xanthan gum solution at initial conditions is shown in Figure 9a. The reduction in viscosity from 6000 ppm to 18000 ppm salinity varies from 19.7% to 20.9%. Meanwhile, the viscosity of the mixture of porang and Xanthan gum at initial conditions is shown in Figure 10a. The decrease in viscosity from 6000 ppm to 18000 ppm salinity varies from 22.6% to 27.3%.

The addition of NaCl levels will shorten the polymer chains so that the viscosity decreases, while with increasing concentration values of the polymer solution the viscosity values also increase. These results support previous research which stated that the higher the polymer concentration value, the higher the viscosity value of the polymer solution and the higher the salinity value, the lower the viscosity value of the resulting polymer solution (Afdi, 2022; Frigrina et al., 2017; Ulfah, 2023). The effect of adsorption on the viscosity of the porang solution is shown in Figure 8. The reduction in viscosity after adsorption on 40 mesh sand (Figure 8b) varies from 9.1% to 28.3%. Meanwhile, the decrease in viscosity after adsorption on 60 mesh sand (Figure 8c) varies from 18.4% to 34.8%.

The effect of adsorption on the viscosity of the Xanthan gum solution is shown in Figure 9. The reduction in viscosity after adsorption on 40 mesh sand (Figure 9b) varies from 22.5% to 45.3%. Meanwhile, the decrease in viscosity after adsorption on 60 mesh sand (Figure 9c) varies from 27.8% to 49.1%.

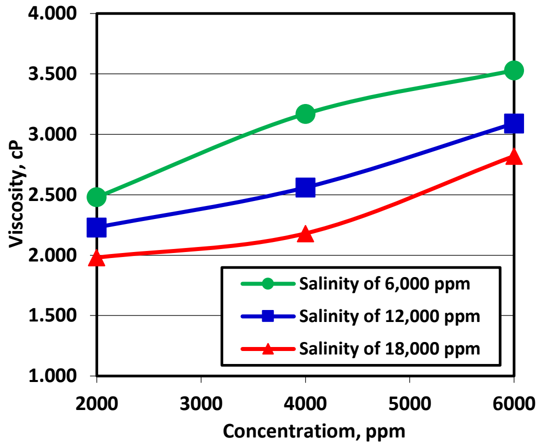
The effect of adsorption on the viscosity of the mixed solution of porang and Xanthan gum is shown in Figure 10. The reduction in viscosity after adsorption on 40 mesh sand (Figure 10b) varied from 18.9% to 46.4%. Meanwhile, the decrease in viscosity after adsorption on 60 mesh sand (Figure 10c) varies from 11.8% to 51.6%.

After the adsorption process, the viscosity decreases, because some of the polymer particles are adsorbed on the rock surface so that the polymer concentration in the solution is reduced. In addition, based on these results, it shows that the effect of adsorption on the Xanthan gum solution causes a higher percentage reduction in viscosity than the reduction in viscosity due to adsorption on the porang solution.

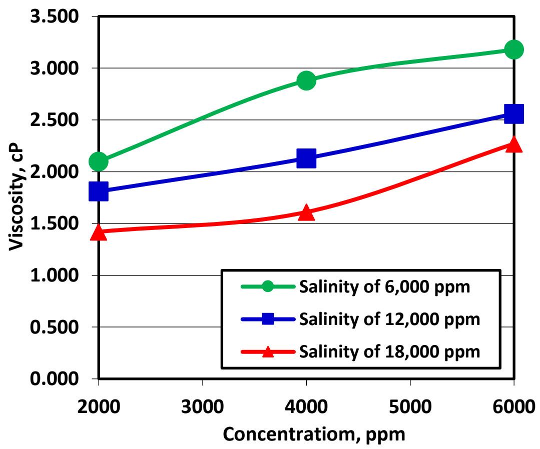
Tables 1 to 3 respectively show the results of adsorption measurements of porang solution, Xanthan gum, and a mixture of porang and Xanthan gum with salinities of 6000 ppm, 12000 ppm, and 18000 ppm on sand grains with sizes of 40 mesh and 60 mesh. In general, Tables 1 to 3 show that increasing salinity causes an increase in polymer adsorption. The compression of the double layer as a result of the increased ionic strength of the solution causes an increase in adsorption along with an increase in NaCl content. This makes it easier for the polymer to get closer to the solid surface (Figdore, 1982; Paternina et al., 2020). In addition, Tables 1 to 3 also show that the number of polymer particles adsorbed on 60 mesh sand grains is greater than 40 mesh. Adsorption on 60 mesh sand is greater than 40 mesh sand because the total surface area of small grains (60 mesh) for the same weight of sand pile is wider than large grains (40 mesh). The adsorption phenomenon causes the viscosity and density of the solution to decrease.

Comparison of Tables 2 and 3 shows that the adsorption of the mixture of porang and Xanthan gum is lower than the adsorption of porang. The highest adsorption change was found in a solution sample with a concentration of 6,000 ppm and a salinity of 6,000 ppm with an adsorption reduction value of 1,007 mg/gr. Meanwhile, the lowest adsorption change was found in samples with a concentration of 4,000 ppm and a salinity of 18,000 ppm with an adsorption reduction value of 0.125 mg/gr. Both are in solution condition in contact with 60 mesh sand.

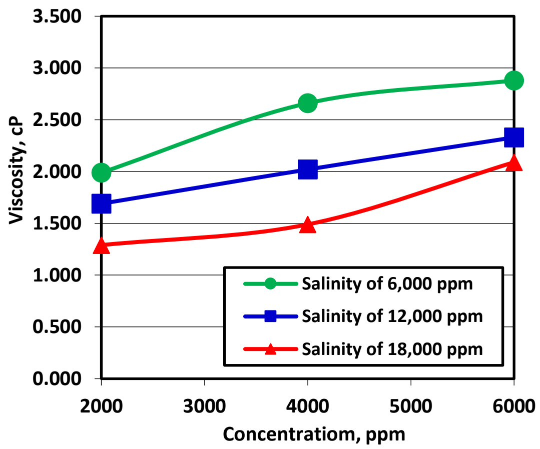
The sandpack flooding test was carried out to see the results of oil pressure by formation water and the selected polymer solution. The solution is selected from each type of solution based on the highest viscosity value. The selected solutions of porang (P), Xanthan gum (X), and a mixture of porang and Xanthan gum (PX) respectively have viscosities of 3.53 cP, 203.49 cP, and 284.72 cP. The characteristics and performance of water flooding of 2 PV followed by Polymer Flooding of 1.33 PV are shown in Table 4 and Figure 11. The oil recovery factor (RF) produced by Water Flooding varies from 76.8% to 77.8%. Meanwhile, the oil recovery factor with porang solution, Xanthan gum, and a mixture of porang and the mixture of porang and Xanthan gum after waterflooding respectively provided additional RF of 6.9%, 10.3% and 16.1%. Based on a comparison of these results, the flood polymer using a mixture of porang and Xanthan gum has the highest viscosity value and provides the highest additional RF. This is in line with previous research, namely that polymer injection can increase oil recovery due to an increase in the viscosity value of the pressing fluid to increase sweeping efficiency (Adianto, 2022; Afdi, 2022; Rita, 2012; Sydansk & Zeron, 2011; Ulfah, 2023).



A. at initial condition

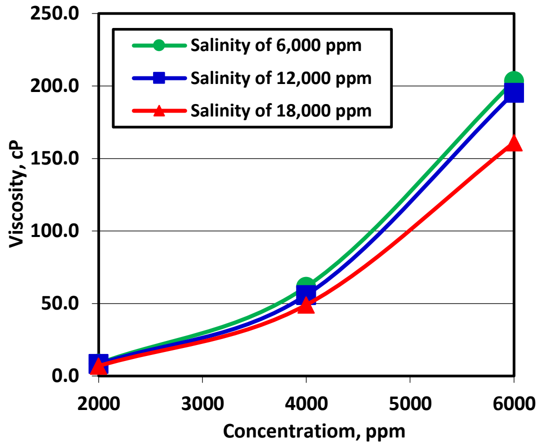


B. After adsorption with 40 mesh sand grains

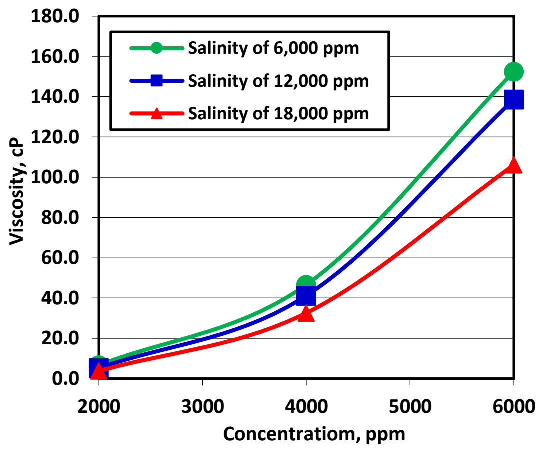


C. After adsorption with 60 mesh sand grains

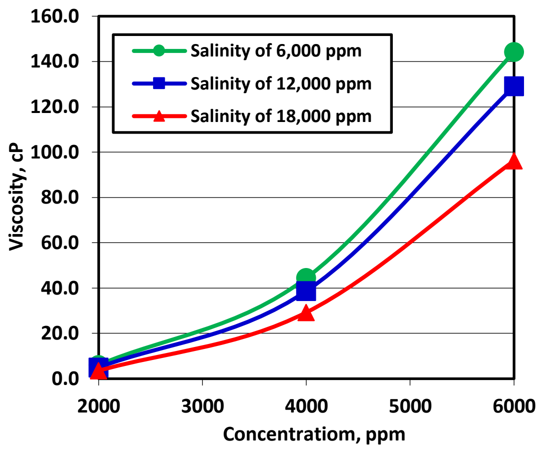
Figure 8. Results of viscosity measurements of porang solution before and after adsorption for various salinities.



A. at initial condition



B. After adsorption with 40 mesh sand grains



C. After adsorption with 60 mesh sand grains

Figure 9. Results of viscosity measurements of Xanthan gum solution before and after adsorption for various salinities.

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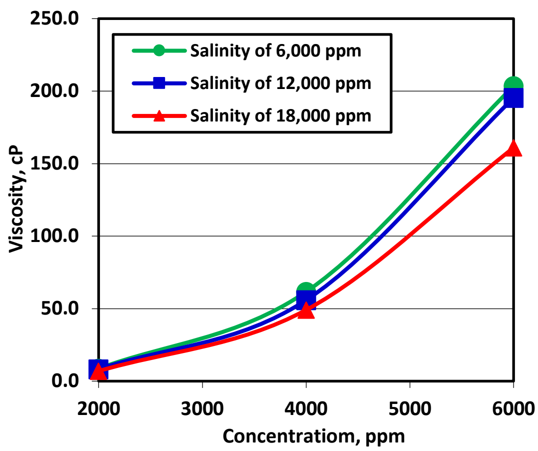
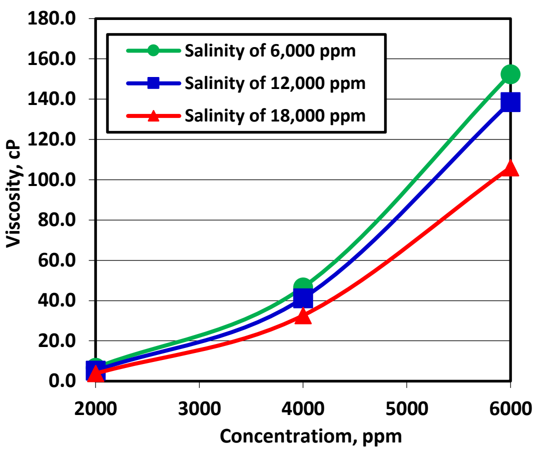
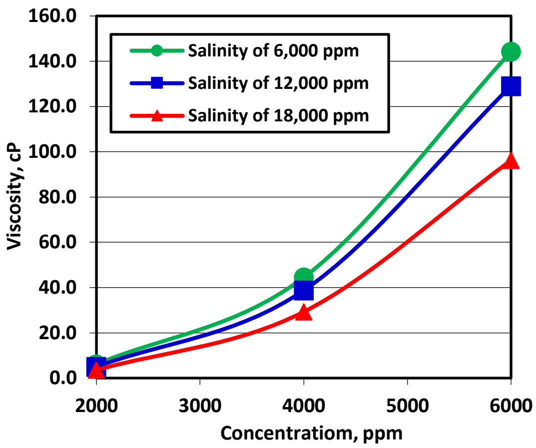


A. at initial condition



B. After adsorption with 40 mesh sand grains



C. After adsorption with 60 mesh sand grains

Figure 10. Results of viscosity measurements of Xanthan gum solution before and after adsorption for various salinities.

Table 1. Results of adsorption measurements of porang solution for various salinities.

No.	Salinity, ppm	Concentration, ppm	Equilibrium concentration C_e, mg/g		Adsorbed polymer Q_e, mg/g	
			40 mesh	**60 mesh**	**40 mesh**	**60 mesh**
1	6000	2000	1067.7	286.5	2.331	4.284
2	6000	4000	2630.2	1849.0	3.424	5.378
3	6000	6000	3724.0	2786.5	5.690	8.034
4	12000	2000	1026.9	218.9	2.433	4.453
5	12000	4000	2390.6	1330.0	4.024	6.675
6	12000	6000	3552.2	2441.1	6.120	8.897
7	18000	2000	830.2	113.2	2.925	4.717
8	18000	4000	1924.5	1283.0	5.189	6.792
9	18000	6000	2943.4	2188.7	7.642	9.528

Table 2. Results of adsorption measurements of Xanthan gum solution for various salinities.

No.	Salinity, ppm	Concentration, ppm	Equilibrium concentration C_e, mg/g		Adsorbed polymer Q_e, mg/g	
			40 mesh	**60 mesh**	**40 mesh**	**60 mesh**
1	6000	2000	1302.5	396.7	1.744	4.008
2	6000	4000	2936.6	1764.4	2.658	5.589
3	6000	6000	4712.8	3149.8	3.218	7.126
4	12000	2000	969.9	85.9	2.575	4.785
5	12000	4000	2664.2	1651.3	3.339	5.872
6	12000	6000	4469.0	3014.1	3.828	7.465
7	18000	2000	629.3	49.8	3.427	4.875
8	18000	4000	2348.9	1563.9	4.128	6.090
9	18000	6000	4218.1	2722.7	4.455	8.193

Table 3. Results of adsorption measurements of porang & Xanthan gum solution for various salinities.

No.	Salinity, ppm	Concentration, ppm	Equilibrium concentration C_e, mg/g		Adsorbed polymer Q_e, mg/g	
			40 mesh	**60 mesh**	**40 mesh**	**60 mesh**
1	6000	2000	1385.4	479.6	1.536	3.801
2	6000	4000	3055.1	1953.8	2.362	5.115
3	6000	6000	4760.2	3552.4	3.099	6.119
4	12000	2000	1221.6	208.7	1.946	4.478
5	12000	4000	2860.7	1718.8	2.848	5.703
6	12000	6000	4518.1	3376.3	3.705	6.559
7	18000	2000	1071.7	174.5	2.321	4.564
8	18000	4000	2735.2	1613.7	3.162	5.966
9	18000	6000	4364	3034.3	4.097	7.414

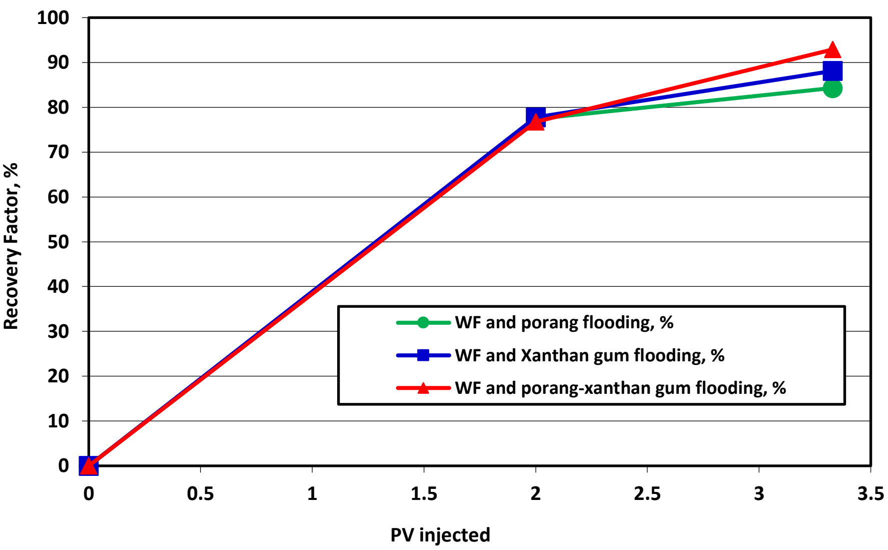


Figure 11. Oil recovery by waterflooding followed by polymer flooding.

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Table 4. Characteristics and performance of waterflooding and polymer flooding.

	Solution		
Parameter	**P**	**X**	**PX**
PV, cc	15.0	14.9	15.2
ϕ, %	60.9	60.5	61.7
OOIP, cc	10.6	11.3	11.2
Soi, %	70.7	75.8	73.7
Np_{wf}, cc	8.2	8.7	8.6
RF_{wf}, %	77.4	77.8	76.8
Np_{pf}, cc	0.73	1.4	1.8
RF_{pf}, %	6.9	10.3	16.1

CONCLUSION

Based on the research results obtained from laboratory experimental testing of porang and xanthan gum solutions, it can be concluded as follows.

1. Based on the results of the compatibility test, all samples of porang, xanthan gum and porang-xanthan gum solutions tested had no sediment and the transmittance value was more than 50%. All samples are compatible with formation water salinities of 6,000 ppm, 12,000 ppm and 18,000 ppm with varying concentrations of 2,000 ppm, 4,000 ppm and 6,000 ppm.

2. Based on the results of the viscosity test, the addition of porang, xanthan gum, and a mixture of porang and xanthan gum can increase the viscosity value of the two polymers. The highest viscosities of porang, xanthan gum, and a mixture of porang and xanthan gum were 3.53 cP, 203.49 cP), and 230.19 cP, respectively.

3. Based on the results of the adsorption test, the addition of porang to the Xanthan gum polymer can reduce the adsorption value, with the highest decrease in adsorption value, namely 1,007 mg/gr in a mixed solution of porang and mesh.

4. Based on the results of the sandpack flooding test, the addition of porang to Xanthan gum produces the highest incremental recovery factor value, namely 16.1%.

NOMENCLATURE

PV = pore volume, cc

ϕ = porositas, %

Np_{pf} = cumulative oil produced due to polymer flooding, cc

Np_{wf} = cumulative oil produced due to water flooding, cc

OOIP = original oil in place, cc

RF_{pf} = recovery factor due to polymer flooding, %

RF_{wf} = recovery factor due to water flooding, %

S_{oi} = initial oil saturation, %

ACKNOWLEDGEMENTS

We would like to appreciate The Ministry of Education, Culture, Research and Technology, Indonesia, for supporting this work with Bima Research Grant Program (number 832/LL3/AL.04/2024). The author would like to thank Trisakti University for providing supplementary funds (no. 174/A/LPPM-P/USAKTI/VI/2024) needed to publish this research.

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SURAT PERNYATAAN TANGGUNG JAWAB BELANJA

Yang bertanda tangan di bawah ini :

Nama : MUHAMMAD TAUFIQ FATHADDIN S.T, M.T, Ph.D

Alamat :

berdasarkan Surat Keputusan Nomor 0459/E5/PG.02.00/2024 dan Perjanjian / Kontrak Nomor 832/LL3/AL.04/2024 mendapatkan Anggaran Penelitian Analisis Karakteristik dan Kinerja Xathan Gum dengan Penambahan Porang untuk Peningkatan Perolehan Minyak Menuju Teknologi Ramah Lingkungan Sebesar Rp.33.560.000

Dengan ini menyatakan bahwa :

1. Biaya kegiatan Penelitian di bawah ini meliputi :

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2	**Pengumpulan Data** Dana telah digunakan sebagian untuk rapat dalam kantor	Rp.1.360.000	Rp.400.000
3	**Analisis Data** Dana untuk analisis data telah digunakan untuk uji kompatibilitas, viskositas, adsorpsi, waterflooding, dan polymer flooding	Rp.10.880.000	Rp.15.600.000
4	**Sewa Peralatan**	Rp.0	Rp.0
5	**Pelaporan Luaran Wajib** Dana telah digunakan untuk proofread manuskrip untuk jurnal internasional bereputasi (Q2) dalam status perbaikan setlah review	Rp.1.360.000	Rp.0
6	**Lain-lain**	Rp.0	Rp.0
Realisasi (80 %)			Rp.31.436.798

2. Jumlah uang tersebut pada angka 1, benar-benar dikeluarkan untuk pelaksanaan kegiatan Penelitian dimaksud.

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, 29-09-2024, Ketua

MUHAMMAD TAUFIQ FATHADDIN S.T, M.T, Ph.D

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