

## DAFTAR ISI

<b>SAMPUL</b> .....	<b>i</b>
<b>JUDUL</b> .....	<b>ii</b>
<b>PERNYATAAN KEASLIAN TULISAN</b> .....	<b>ii</b>
<b>LEMBAR PENGESAHAN</b> .....	<b>iv</b>
<b>KATA PENGANTAR</b> .....	<b>vi</b>
<b>HALAMAN PERSEMBAHAN</b> .....	<b>vii</b>
<b>RINGKASAN</b> .....	<b>viii</b>
<b>RESUME</b> .....	<b>ix</b>
<b>DAFTAR ISI</b> .....	<b>x</b>
<b>DAFTAR GAMBAR</b> .....	<b>xii</b>
<b>DAFTAR TABEL</b> .....	<b>xiv</b>
<b>DAFTAR LAMPIRAN</b> .....	<b>xv</b>
<b>DAFTAR PERISTILAHAN</b> .....	<b>xvi</b>
<b>BAB I PENDAHULUAN</b> .....	<b>1</b>
1.1. Latar Belakang dan Permasalahan.....	1
1.2. Rumusan Permasalahan .....	2
1.3. Maksud dan Tujuan Penelitian .....	3
1.4. Batasan Penelitian.....	3
1.5. Manfaat Penelitian .....	3
1.6. Hipotesis Penelitian .....	4
1.7. Struktur Penulisan.....	4
<b>BAB II TINJAUAN UMUM LAPANGAN</b> .....	<b>5</b>
2.1. Lokasi dan Sejarah Lapangan KLO .....	5
2.2. Geologi Regional .....	5
2.3. Tatanan Tektonik dan Struktur Geologi .....	6
2.4. Riwayat Sumur dan Produksi.....	7
<b>BAB III STUDI LITERATUR</b> .....	<b>9</b>
3.1. Studi Literatur .....	9

## **BAB IV TEORI DASAR & METODOLOGI PENGOPERASIAN**

<b><i>VERTICAL CUTTING DRYER (VCD) DALAM MUD CONDITIONING ...</i></b>	<b>14</b>
4.1. <i>Synthetic-Based Mud (SBM)</i> .....	14
4.2. <i>Solid Control Equipment (SCE)</i> .....	17
4.2.1. <i>Mud Conditioning</i> .....	18
4.3. <i>Aspek Teknis Vertical Cutting Dryer (VCD) Package</i> .....	22
4.3.1. <i>Operasional Vertical Cutting Dryer (VCD) Package</i> .....	23
4.3.2. <i>Pengoperasian</i> .....	29
4.3.3. <i>Maintenance</i> .....	30
4.3.4. <i>Troubleshooting</i> .....	32
4.4. <i>Mud Material Balance</i> .....	33
4.5. <i>Mud Recovery</i> .....	34
4.6. <i>Cutting Concentration (C<sub>a</sub>)</i> .....	35
4.7. <i>Retort Test terhadap %OOC</i> .....	36
4.8. <i>Conditioning &amp; Produk oleh VCD dan Solid Control</i> .....	38
4.9. <i>Aspek Pembiayaan &amp; Keekonomian</i> .....	39
4.10. <i>Metodologi Penelitian</i> .....	42
4.10.1. <i>Diagram Alir Penelitian</i> .....	43

## **BAB V HASIL PERHITUNGAN TEKNIS DAN KEEKONOMIAN**

<b><i>PENGOPERASIAN VERTICAL CUTTING DRYER (VCD) DALAM MUD CONDITIONING.....</i></b>	<b>47</b>
5.1. <i>Problematika Mud &amp; Cutting Treatment pada Operasi Pengeboran</i> .....	47
5.1.1. <i>Mud Losses in Cutting</i> .....	49
5.1.2. <i>Kenaikan Densitas Lumpur</i> .....	49
5.1.3. <i>Kegagalan Shale Shaker Screen</i> .....	50
5.1.4. <i>Cutting Concentration (C<sub>a</sub>)</i> .....	51
5.1.5. <i>Cutting &amp; Screen Size</i> .....	53
5.2. <i>Optimasi Parameter VCD System</i> .....	54
5.2.1. <i>Optimasi Screw Conveyor Auger Capacity</i> .....	55
5.2.2. <i>Optimasi VCD CSI WSM-04 Capacity &amp; RPM Optimum</i> .....	58
5.2.3. <i>Optimasi Decanter DE-1000 FHD Capacity</i> .....	60
5.2.4. <i>Nilai %OOC pada VCD &amp; Solid Control Equipment</i> .....	63
5.3. <i>Mud Conditioning terhadap Mud Rheology &amp; Properties</i> .....	65
5.4. <i>Produk Treatment &amp; Conditioning</i> .....	67
5.4.1. <i>Proses Treatment pada VCD CSI WSM-04 Package</i> .....	67
5.4.2. <i>Proses Treatment pada Decanter</i> .....	70
5.5. <i>Perbandingan Keekonomian Model Konvensional dan Kombinasi VCD...</i>	76
5.5.1. <i>VCD Package Rental Cost</i> .....	76
5.5.2. <i>Mud Recovery dari VCD Processing</i> .....	78

5.5.3. <i>Cutting Handling Cost</i> dari Model VCD & <i>Decanter</i> DE-1000 FHD .	80
5.5.4. Akumulasi Biaya <i>Surface Mud Losses</i> .....	82
5.5.5. Skenario Pembiayaan dengan Model Konvensional .....	85
5.5.6. Perbandingan Keekonomian.....	91

<b>BAB VI PEMBAHASAN TEKNIS DAN KEEKONOMIAN</b>	
<b>PENGOPERASIAN <i>VERTICAL CUTTING DRYER</i> (VCD) DALAM MUD</b>	
<b><i>CONDITIONING</i> DI SUMUR KLO-31 LAPANGAN YAKIN .....</b>	<b>93</b>
6.1. Problematika <i>Mud &amp; Cutting Treatment</i> .....	93
6.2. Optimasi Parameter VCD System .....	94
6.3. <i>Mud Conditioning</i> terhadap <i>Mud Rheology &amp; Properties</i> .....	96
6.4. Produk <i>Treatment &amp; Conditioning</i> .....	97
6.5. Perbandingan Keekonomian Model Konvensional dan Kombinasi VCD...	98
<b>BAB VII KESIMPULAN .....</b>	<b>101</b>
<b>DAFTAR PUSTAKA .....</b>	<b>103</b>
<b>DAFTAR SIMBOL .....</b>	<b>106</b>
<b>LAMPIRAN.....</b>	<b>108</b>

## DAFTAR GAMBAR

	<b>Halaman</b>
Gambar 2.1. Stratigrafi dan Litologi di Lapangan Yakin .....	6
Gambar 2.2. <i>Well Schematic</i> Sumur KLO-31 (YN-31) .....	13
Gambar 4.1. Skema Optimasi <i>Solid Removal</i> pada <i>Mud Conditioning</i> .....	18
Gambar 4.2. <i>Shale Shaker</i> .....	20
Gambar 4.3. <i>Degasser</i> .....	21
Gambar 4.4. <i>Desander</i> .....	22
Gambar 4.5. <i>Desilter</i> .....	22
Gambar 4.6. <i>Vertical Cutting Dryer</i> CSI WSM-04 (1) & <i>Decanter</i> (2) .....	23
Gambar 4.7. Alur Pemrosesan <i>Cutting</i> pada VCD .....	24
Gambar 4.8. Alur Proses <i>Mud &amp; Cutting Processing</i> Kombinasi VCD .....	24
Gambar 4.9. <i>Wire Screen</i> 0,020” (508 microns) .....	31
Gambar 4.10. Fann 140 <i>Regular Mud Balance</i> .....	34
Gambar 4.11. Diagram Alir Penelitian .....	43
Gambar 4.12. <i>Layout</i> Penempatan <i>Vertical Cutting Dryer</i> (VCD) di <i>Jackup Rig</i> 46	46
Gambar 5.1. <i>Well Schematic</i> Sumur KLO-31 .....	47
Gambar 5.2. Grafik <i>Cutting Concentration</i> (%) .....	53
Gambar 5.3. <i>Cutting &amp; Screen Size Analysis</i> pada Sumur KLO-31 .....	53
Gambar 5.4. Skema Instalasi VCD <i>Package</i> .....	54
Gambar 5.5. Kapasitas Alir <i>Screw Conveyor Auger</i> (ton/hr) .....	58
Gambar 5.6. Optimasi VCD CSI WSM-04 <i>Capacity</i> .....	60
Gambar 5.7. Optimasi <i>Flowrate</i> pada <i>Decanter</i> DE-1000 FHD <i>Series</i> .....	62
Gambar 5.8. Perbandingan Nilai %OOC .....	65
Gambar 5.9. Produk <i>Treatment</i> oleh VCD .....	69
Gambar 5.10. <i>Treatment</i> oleh <i>Decanter</i> pada <i>Mud Losses, Cake &amp; Centrate</i> .....	75
Gambar 5.11. Biaya Sewa VCD <i>Package</i> /Kumulatif Jam/Trayek .....	78
Gambar 5.12. <i>Cutting Handling Cost Model</i> VCD & <i>Decanter</i> DE-1000 FHD ..	82
Gambar 5.13. <i>Surface Mud Losses Cost</i> .....	84

Gambar 5.14. Pembiayaan dengan Model Konvensional .....	90
Gambar 5.15. Perbandingan Keekonomian .....	92

## DAFTAR TABEL

	<b>Halaman</b>
Tabel II-1. Sejarah Operasi Lapangan Migas ‘KLO’ .....	7
Tabel III-1. Matriks Riwayat Penelitian, Teknologi & Parameter.....	13
Tabel IV-1. Katalog Komposisi Lumpur <i>Synthetic Base Mud</i> (SBM) .....	15
Tabel IV-2. Perbandingan Ukuran Kebundaran Batuan .....	18
Tabel IV-3. Gejala, Sebab dan Solusi Permasalahan pada VCD.....	29
Tabel V-1. Studi Kasus pada Sumur KLO-30 .....	48
Tabel V-2. <i>Cutting Concentration</i> (%) .....	51
Tabel V-3. Optimasi <i>Screw Conveyor Auger 14”</i> .....	55
Tabel V-4. Optimasi VCD CSI WSM-04 <i>Capacity &amp; RPM Optimum</i> .....	59
Tabel V-5. Optimasi <i>Decanter DE-1000 FHD Capacity</i> .....	61
Tabel V-6. Perbandingan %OOC pada VCD & <i>Solid Control Equipment</i> .....	63
Tabel V-7. <i>Mud Rheology &amp; Properties</i> pada Trayek 12-1/4” .....	66
Tabel V-8. <i>Mud Rheology &amp; Properties</i> pada Trayek 8-1/2” .....	66
Tabel V-9. Produk <i>Treatment</i> oleh VCD .....	68
Tabel V-10. Produk <i>Treatment</i> oleh <i>Decanter</i> .....	70
Tabel V-11. VCD <i>Rental Cost</i> berdasarkan Kumulatif <i>Running Hours</i> /Trayek ..	76
Tabel V-12. <i>Mud Recovery</i> dari VCD <i>Processing</i> .....	79
Tabel V-13. <i>Cutting Handling Cost</i> dari Model VCD & <i>Decanter DE-1000</i> .....	80
Tabel V-14. <i>Surface Mud Losses Cost</i> .....	83
Tabel V-15. Pembiayaan dengan Model Konvensional.....	88
Tabel V-16. Biaya Minimum Pembuatan dan Perawatan Lumpur SBM .....	89
Tabel V-17. Perbandingan Keekonomian .....	91

## DAFTAR LAMPIRAN

	<b>Halaman</b>
Lampiran 1. <i>Cutting Concentration (%)</i> .....	109
Lampiran 2. Pengaturan Parameter <i>Screw Conveyor Auger 14"</i> .....	110
Lampiran 3. Pengaturan Parameter VCD CSI WSM-04 .....	111
Lampiran 4. Pengaturan Parameter <i>Decanter DE-1000 FHD Series</i> .....	112
Lampiran 5. Perbandingan %OOC pada VCD & <i>Solid Control Equipment</i> .....	113
Lampiran 6. <i>Mud Rheology &amp; Properties</i> Seluruh Trayek .....	114
Lampiran 7. Produk <i>Treatment</i> oleh VCD.....	115
Lampiran 8. Produk <i>Treatment</i> oleh <i>Decanter</i> .....	116
Lampiran 9. <i>VCD Rental Cost</i> Sumur KLO-31 .....	117
Lampiran 10. <i>Mud Recovery</i> dari <i>VCD Processing</i> .....	118
Lampiran 11. <i>Cutting Handling Cost</i> dari Model VCD & <i>Decanter DE-1000</i> ..	119
Lampiran 12. <i>Surface Mud Losses Cost</i> .....	120
Lampiran 13. Pembiayaan dengan Model Konvensional .....	121
Lampiran 14. Biaya Minimum Pembuatan dan Perawatan Lumpur SBM .....	122
Lampiran 15. Perbandingan Keekonomian.....	123

## DAFTAR PERISTILAHAN

AHTS	<i>Anchor Handling &amp; Tug Supply</i>
AFE	<i>Authorization for Expenditure</i>
API	American Petroleum Institute
bbbl	<i>Barrel</i>
BCF	<i>Billion Cubic Feet</i>
BHA	<i>Bottom Hole Assembly</i>
BHP	<i>Bottom Hole Pressure</i>
CaCl	Kalsium Klorida
CO <sub>2</sub>	Karbondioksida
CP	<i>Conductor Pipe</i>
DDR	<i>Daily Drilling Report</i>
DMR	<i>Drilling Mud Report</i>
DSCR	<i>Daily Solid Control Report</i>
DWM	<i>Drilling Waste Management</i>
ECD	<i>Equivalent Circulating Density</i>
EPA	Environmental Protection Agency
ft	<i>Feet</i>
GS	<i>Gel Strength</i>
H <sub>2</sub> S	Hidrogen Sulfida
HGS	<i>High Gravity Solid</i>
IADC	International Association of Drilling Contractors
ISO	International Standard Organization
KCl	Kalium Klorida
KLO	<i>Kalimantan Operations</i>
MD	<i>Measured Depth</i>
MMBOE	<i>Million Barrels of Oil Equivalent</i>
MW	<i>Mud Weight</i>



NADF	<i>Non-Aqueous Drilling Fluid</i>
OBM	<i>Oil Base Mud</i>
OGIP	<i>Original Gas in Place</i>
OOIP	<i>Original Oil in Place</i>
OWR	<i>Oil &amp; Water Ratio</i>
PDC	<i>Polycrystalline Diamond Compact</i>
PHKT	<i>PT Pertamina Hulu Kalimantan Timur</i>
POOH	<i>Pump Out of Hole</i>
POP	<i>Put on Production</i>
PPLI	<i>PT Prasadha Pamunah Limbah Industri</i>
pH	<i>Potential Hydrogen</i>
ppg	<i>Pound per Gallon</i>
psi	<i>Poun/Inch<sup>2</sup></i>
PV	<i>Plastic Viscosity</i>
R/U	<i>Rig Up</i>
R&D	<i>Research &amp; Development</i>
RF	<i>Recovery Factor</i>
RM	<i>Recovered Mud</i>
ROC	<i>Retention on Cutting</i>
ROP	<i>Rate of Penetration</i>
rpm	<i>Revolution per Minute</i>
SBI	<i>PT Solusi Bangun Indonesia</i>
SBM	<i>Synthetic Base Mud</i>
SCE	<i>Solid Control Equipment</i>
SF	<i>Safety Factor</i>
SF-05	<i>Smooth Fluid 05</i>
SG	<i>Specific Gravity</i>
TCC	<i>Thermomechanical Cutting Cleaner</i>
TD	<i>Total Depth</i>
TDU	<i>Thermal Desorption Unit</i>
TVD	<i>True Vertical Depth</i>

TVDSS	<i>True Vertical Depth Subsea</i>
UNOCAL	Union Oil California
USD	United States <i>Dollar</i>
UR	<i>Under Reamer</i>
VCD	<i>Vertical Cutting Dryer</i>
VG	<i>Viscometer &amp; Gel Strength</i>
WBM	<i>Water Base Mud</i>
YP	<i>Yield Point</i>
%HGS	<i>Persen High Gravity Solid</i>
%LGS	<i>Persen Low Gravity Solid</i>
%OOC	<i>Persen Oil on Cutting</i>