

Water Pollution Evaluation as Consequent Of Old Wells Oil Exploration (Case study of Angit River village at Babat Toman District of Musi Banyuasin)

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Abstract

This research was aimed to investigate effect of oil spills on surface water from exploration in Dutch well. The investigation was carried out by in situ measurement of some parameters. Water sample was collected by grab sampling method and the analysis was conducted at Laboratory of Environment Badan Lingkungan Hidup dan Penelitian Pengembangan (BLHPP) Kabupaten Musi Banyuasin. The measurement result showed that some parameters did not fulfill the requirement of Standar Quality for Domestic Water Regulation according to Government Regulation No. 82 year 2001 i.e. COD and Oil&Fat content. The surface water and shallow ground water quality had some parameters that did not comply with standar quality according to regulation such as BOD, COD, DO, and oil-fat content. Calculation of pollution indeks (PI) showed that domestic water has 3.26 and was categorized into slightly polluted. At surface water in Angit River, the calculation of PI showed that upstream river was slightly polluted (3.23), while midstream was slightly polluted (3.22) and in downstream river was mildly polluted (9.60).

Keywords: oil exploitation, oil spills, water pollution.

Abstrak

Penelitian ini bertujuan untuk mengkaji pengaruh tumpahan minyak terhadap kualitas air tanah dangkal dan air permukaan Sungai Angit. Penelitian meliputi pengukuran beberapa parameter secara *in-situ*, pengambilan sampel air secara *grab sampling*, analisis sampel air dilakukan di Laboratorium Lingkungan Badan Lingkungan Hidup dan Penelitian Pengembangan (BLHPP) Musi Banyuasin. Hasil dari pengukuran sample air dangkal (sumur penduduk) menunjukkan ada beberapa parameter pengukuran yang tidak memenuhi baku mutu lingkungan (BML) sesuai standar Peraturan Pemerintah RI Nomor 82 Tahun 2001 seperti COD dan kandungan minyak-lemak. Pengukuran sample air permukaan di Sungai Angit menunjukkan ada beberapa parameter pengukuran yang tidak memenuhi baku mutu lingkungan (BML) sesuai standar PP RI Nomor 82 Tahun 2001 yaitu BOD5, COD, DO, dan kandungan minyak-lemak. Hasil dari perhitungan Indeks Pencemaran (IP) sebesar 3.26 menunjukkan bahwa air dangkal tercemar ringan. Indeks Pencemaran di air Sungai Angit menunjukkan bahwa air di hulu mempunyai nilai IP sebesar 3,23 dan air di tengah mempunyai IP sebesar 3,22 yang menunjukkan bahwa air tersebut tercemar ringan. Sedangkan di bagian hilir kegiatan di sungai nilai IP sebesar 9,60 yang menunjukkan bahwa air di hilir kegiatan Sungai Angit tercemar sedang.

Kata Kunci: pertambangan minyak bumi, tumpahan minyak bumi, pencemaran air.

INTRODUCTION

Village of Angit River located at Babat Toman Sub-District, District of Musi Banyuasin is a village with old wells of oil which still has potential petroleum mining. The

mining activity can produce approximately 400–500 oil barrel per day. Petroleum mining management practiced on old oil well at Angit River is still in traditional manner. The mining is conducted by hand and is assisted by wood

tripod. Oil spills is inevitable in this mining technique therefore could give deteriorated influence on environment especially water and land quality.

According to regulation provided by ministry of energy and mineral resources, old oil wells is an oil reservoir which had been explored prior 1970 located at non-operated field in the region which no longer under exploration contract by any operator. The oil wells therefore officially are not under legal operation and can be considered as being abandoned.

Oil may caused pollution especially in water due to exploitation and exploration activity which involve refinery process, transportation and piping. Such activities may leak and spills oil into environment and caused water pollution (Nuryantini dan Edi (2010)). Old wells oil exploration as a matter of fact increase the living of occupants economically. However, its traditional method and lack of technical standard and environmental safety lead to oil spills which caused water pollution.

Government regulation on toxic and hazardous materials waste management no. 18 year 1999 and no. 85 year 1999 stated that oil spills in the area of oil exploration is categorized as toxic and hazardous materials coded 220. Toxic and hazardous materials defined as materials which endanger both human health and the environment. The materials usually are explosive, easy to burn, chemically reactive, harmful, causing infection, corrosive and carcinogenic.

Here we report the effect of oil spills due to traditional exploration on water resources i.e. surface water and shallow well. The government regulation is used as reference of standard threshold on some parameters measured.

MATERIAL AND METHODS

Materials

Water sample was taken at Village of Angit River located at Babat Toman Sub-District, District of Musi Banyuasin.

Sampling Method

The location of sampling was purposely chosen based on the number of exploration activity conducted in traditional manner.

Samples were taken by means of grab sampling method and were analyzed both in the field and laboratory in accordance with standard procedures. Surface water was taken from Angit River whereas shallow wells water owned by local resident was taken 50 m from exploration site. The Sampling location of Angit River is displayed on Table 1.

Table 1. Sampling location of Angit River.

Station	Coordinate	Position
A.1	S 02°39'23,2" E 103°34'44,5"	Up stream of exploration location of oil old wells
A.2	S 02°39'22,0" E 103°34'48,8"	Mid stream of exploration location of oil old wells
A.3	S 02°39'38,5" E 103°34'34,5"	Down stream of exploration location of oil old wells
A.4	S 02°39'22,8" E 103°34'44,7"	Waste water of oil old wells exploration
A.5	S 02°39'30,0" E 103°34'48,0"	Wells owned by local resident distance 20 m (Shallow wells water)

Analysis Data

Water samples were treated and analyzed by using appropriate method to obtain parameters value needed on investigation process. The method and parameters to be determined is displayed on Table 2.

Table 2. Result of parameters measurement of waste water from exploration activity.

Parameter	Max. value allowed	Method
COD	300 mg/l	SNI 06-6989.2-2004
Oil and fat	25 mg/l	SNI 06.6989.10-2004
NH ₃ N	10 mg/l	SNI 06.6989.30-2005
Temperature	45°	SNI 06-6989.23-2005
pH	6 – 9	SNI 06-6989.11-2004
TDS	4000 mg/l	SNI 06.6989.27-2005

Ref. : Provisioned by ministry of environmental no 19 year 2010

Water samples taken from surface and shallow wells were also treated and analyzed using similar method. The result is showed on Table 3.

Table 3. Result of parameters measurement of surface water and shallow wells water.

Parameter	Unit	Water class	
		Class I	Class III
Physical			
Temperature	°C	Native ± 3	Native ± 3
TDS	mg/l	1000	1000
TSS	mg/L	50	400
Chemical/Inorganic			
pH	-	6 - 9	6 - 9
BOD	mg/L	2	6
COD	mg/L	10	50
DO	mg/l	6	3
NH ₃ N	mg/l	0,5	-
Chemical organic			
Oil and fat	µg/L	1000	1000

Source: PP No 82 2001 Tentang Pengelolaan Kualitas Air dan Pengendalian Pencemaran Air

Data Analysis

Analysis was conducted to define water quality status which indicate water quality level from particular source compare to standard threshold approved. One of method of defining water quality status is using pollution index. Pollution index is adapted by ministry of environmental provision no 115 year 2003 on guideline of water quality status determination.

Pollution index (PI_j) was calculated using the following formula:

$$PI_j = \sqrt{\frac{\left(\frac{C_i}{L_{ij}}\right)_M^2 + \left(\frac{C_i}{L_{ij}}\right)_R^2}{2}} \quad (1)$$

Whereas:

C_i = laboratory analysis result R = average value

L_{ij} = standard threshold value

M = maximum value

Based on the pollution index, the water quality status is classified accordingly. The classification of water quality status is as follow displayed on Table 4.

Table 4. Water quality status according to pollution index

Pollution index	Water quality status
$0 \leq PI \leq 1.0$	Good
$1.0 < PI \leq 5.0$	Slightly polluted
$5.0 < PI \leq 10$	Mildly polluted
$PI > 10$	Heavily polluted

Ref.: Ministry of environmental provision no. 115 year 2003.

RESULT AND DISCUSSION

The acidity of waste water from old wells oil exploration was determined by measuring pH. The pH obtained is 5.71 which indicate waste water is not fulfill the requirement of environmental threshold quality between 6–9 (Ministry provision no. 19 year 2010). Sample analysis result of waste water from old wells oil exploration displayed on Table 5.

Table 5. Sample analysis result of waste water from old wells oil exploration

Parameter	unit	result	Standard threshold*	Status
COD	mg/l	97	300	comply
Oil & fat	mg/l	< 5	25 mg/l	Comply
NH ₃ N	mg/l	3	10	Comply
Temperature	°C	31	45	Comply
pH	#	5,71	6-9	Not comply
TDS	mg/l	3,32	4000	Comply

Sample from shallow ground water resource was tested against several parameters. Result showed COD and oil and fat did not comply standard threshold approved by Government regulation no 82 year 2001. COD result 11 mg/L while oil and fat 10 mg/L exceed maximum value allowed by regulation.

Table 6. Analysis result of water from local resident well.

Parameter	unit	result	Standard threshold* class I	Status
Temperatur	°C	30	native± 3	comply
TDS	mg/l	98	1000	Comply
TSS	mg/l	37	50	Comply
pH	#	6.24	6-9	Comply
BOD ₅	mg/l	1.8	2	Not Comply
COD	mg/l	11	10	Not Comply
DO	mg/l	2.82	6	Not Comply
NH ₃ N	mg/l	0.2	0.5	Comply
Oil and fat	mg/l	< 5	1	Not Comply

Table 6 displayed some parameters did not comply the required value provisioned by the Government regulation no 82 year 2001. The parameters which did not comply are BOD₅, COD, DO and oil and fat.

The result on Table 6 also confirmed that water from Angit river has the highest concentration of BOD₅, COD, DO and oil and fat at downstream. This fact can be seen as result of accumulation process of oil spills from exploration activity of old oil wells. The exploration activity is located near by the river therefore water was polluted inevitably.

The highest BOD₅ value according to laboratory testing is 1535 mg/L which is far above value allowed at 6 mg/L. COD value has highest value at 7872 mg/L while threshold approved is 50 mg/L and DO was obtained at 3.91 mg/L whereas threshold approved is 3 mg/L. The oil and fat parameter showed similar tendency given the analysis result at 10 mg/L where as standard threshold allow only 1 mg/L. Table 8 provide Analysis result of water from Angit River.

Table 7. Analysis result of water from Angit river

Parameter	Up stream	Mid stream	Down stream	Standard
Temperature	30	31	30	native ± 3
TDS	87.1	36.2	26.8	1000
TSS	48	45	66.0	400
pH	6.53	6.12	6.40	6-9
BOD ₅	2	1.65	1535	6
COD	15	9	7872	50
DO	3.62	1.32	3.91	3
NH ₃ N	0.2	0.2	0.40	(-)
Oil and fat	< 5	< 5	10	1

Pollution index calculated for Angit River can be concluded as slightly to mildly polluted. Table 8 provide result of calculation and the status resolved.

Table 8. Pollution index calculation result of Angit river

Location	PI value	Pollution status
Shallow water (Local resident well)	3.26	Slightly polluted
River water (Upstream)	3.23	Slightly polluted
River water (Midstream)	3.22	Slightly polluted
River water (Downstream)	9.60	Mildly polluted

CONCLUSION

The old wells oil exploration at Angit river village caused water pollution due to oil spills. Among the water parameters tested, BOD₅, COD, DO and oil and fat did not comply to required value approved by regulation. Pollution index calculation conclude that water used by local resident at Angit river village is slightly to mildly polluted.

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