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Disposal and reuse of drilling solid waste from a massive gas field

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Abstract

Drilling solid waste is a typical industrial solid waste, and it is a major pollutant source to ecological environment around gas fields. A gas field in Southwest China is a self-contained marine gas field, presently with a large scale and great abundance. It also belongs to the five large gas fields of China with exploration above $2 \times 10^{11} \text{m}^3$. Spot investigation and experimental study showed that the drilling solid waste was made up of drilling mud and rock cuttings. After solidified disposal, the waste belonged to the second general industrial solid waste, and environmental impacts related to the waste water were characterized as pH, COD and SS. According to traffic distance to the local town, alternative control projects were brick production and cement solidification. Drilling solid waste from the central field was collected and piled up in a massive landfill, then gradually calcined to brick; while drilling solid waste from the ambient field was mainly on-the-spot solidified, later for activity site. The study is significant for waste pollution control and gas field management. However, further studies are in progress to solve the problems such as waste water pollution of the massive landfill and the solidified pools, secondary air pollution of the brick factory.

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1. Introduction

Drilling solid waste of most gas fields in China is a stabilized suspended substance, and combined with clay, chemical additives, rock cuttings, weighting materials, oil, etc. It is an impact to human health and the environment. As expected from previous studies, drilling solid waste is treated by solidification and landfilling, incineration, or reclamation after biological treated, building materials or paving stones after solidified, calcined brick combined

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with some clay^[1-5]. In consideration of social, environmental and economic benefits, disposal and reuse of drilling solid waste should be in accordance with local conditions.

The gas field is located in Daba Mountain, with great relief and widespread valley, thus natural environment around is rather sensitive. Since exploited, reduce, reuse and recycle of drilling solid waste is concerned and urgent. Though the work is arduous, it needs to be properly solved in time, for it is related to accomplishment of environment protection object and acceptance by the environmental authorities.

2. Characteristics of drilling solid waste

2.1. Production characteristics of drilling solid waste

Drilling solid waste was produced in construction period of gas well, and included waste mud, rock cuttings, weighting materials, and so on. Waste mud of the drilling field was nearly between 800~1200 m³ per well, rock cuttings were about 1000 m³ per well. In period of drilling, weighting materials may be used when necessary. If emergency probability was 1% and waste yield was 500 m³ per well, weighting materials was 5 m³ per well. Apparently, waste mud and rock cuttings were the main drilling solid waste.

2.2. Physicochemical characteristics of drilling solid waste

Since compound of waste mud and rock cuttings was the main drilling solid waste, the massive landfill received drilling solid waste of the central field was investigated. And the solidified waste was sampled by the common planar method. The solidified waste was loose and of dark grey color. Experimental study showed that density of the solidified waste was 1.75 g/cm³, moisture was 24.0%; and its component, heavy metal content, radioactive element content were respectively presented in Table 1~ Table 3.

Table 1. Component of the solidified drilling solid waste from a gas field

Items	Cl ⁻	SO ₄ ²⁻	Na	Fe	Ca	Mg	Si	Al	CO ₃ ²⁻	petroleum	other
Content (%)	0.1	5.6	1.0	9.0	12.4	6.8	15.8	22.8	10.2	0.4	15.9

As showed in Table 1, main components of the solidified waste mud and rock cuttings were inorganic and organic matters with element of Al, Si, Ca, Fe, individually reached 22.8%, 15.8%, 12.4%, and 9.0% of the sample weight, totally to 60%.

Table 2. Heavy metal content of the solidified drilling solid waste from a gas field

Items	Cd	Hg	Pb	Cr	s	Zn	Ni	Cu	B
Values(mg/kg)	0.3	0.27	43	36	3.2	234	70	40	1.2
Limit (pH≥6.5)	20	15	1000	1000	75	1000	200	500	150
Limit (pH<6.5)	5	5	300	600	75	500	100	250	150

Table 3. Radioactive element content of the solidified drilling solid waste from a gas field

Items (Ra-226、Th-232、K-40)	Internal radiation index I _{Ra}	External irradiation index I _r
Values	0.19	0.37
Limit	1.0	1.3 (1.0)

Heavy metal content was analyzed by “Standard for pollutants control of agricultural sludge” (GB4284-84), and radioactive element content was analyzed by “Limit of radionuclides in building materials” (GB6566-2001). Based on data of Table 2 and Table 3, it was found that both heavy metal content and radioactive element content met national standards of non-metal building material or walling material.

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