Multiscale and Multidisciplinary Modeling, Experiments and Design
https://doi.org/10.1007/s41939-018-0008-x

ORIGINAL PAPER

Using Monte Carlo simulation to estimate geothermal resource in Dholera geothermal field, Gujarat, India

Manan Shah[1] · Dwijen Vaidya[2] · Anirbid Sircar[1]

Received: 30 December 2017 / Accepted: 20 March 2018

Abstract
After effective investigation on various exploration activities, from a geothermal prospect, stakeholders are constantly anxious to know of its potential. Geothermal resource assessment is estimation of the amount of thermal energy that is stored beneath the earth's surface and can be extracted from a geothermal reservoir and used economically for a time frame, normally a very long while. A study was undertaken to calculate energy potential of the Dholera Geothermal Field. Using various parameters from the geoelectrical model, the resource potential beneath the subsurface was calculated by applying Monte Carlo simulation. Using various parameters from the geoelectrical model and applying Monte Carlo simulation, the resource potential beneath the subsurface was calculated. It was calculated considering all uncertain parameters (random values) within the span of the minimum, the most likely and the maximum triangular distribution. The result shows the frequency distribution of energy values. Energy estimated at 3 km depth in Dholera is 3.73×10^{10} J (P50 Case). Energy estimated for P90 case is 2.90×10^{10} J and for P10 case is 3.73×10^{10} J.

Keywords Volumetric method · Monte Carlo simulation · Geothermal energy · Resource estimation

List of Symbols

μ	Mean
σ^2	Variance
Q_T	Total thermal energy (kJ/kg)
Q_r	Heat in rock (kJ/kg)
Q_s	Heat in steam (kJ/kg)
Q_w	Heat in water (kJ/kg)
A	Area of the reservoir (m^2)
h	Average thickness of the reservoir (m)
C_r	Specific heat of rock at reservoir condition (kJ/kgK)
C_l	Specific heat of liquid at reservoir condition (kJ/kgK)
C_s	Specific heat of steam at reservoir condition (kJ/kgK)
ϕ	Porosity
T_i	Average temperature of the reservoir (°C)
T_c	Final or abandonment temperature (°C)
S_w	Water saturation
ρ_{si}	Steam density at reservoir temperature (kg/m^3)
ρ_{wi}	Water density at reservoir temperature (kg/m^3)
H_{si}	Steam enthalpy at reservoir temperature (kJ/kg)
H_{wi}	Water enthalpy at reservoir temperature (kJ/kg)
H_{wf}	Final water enthalpy (kJ/kg)

✉ Manan Shah
manan.shah@spt.pdpu.ac.in

Dwijen Vaidya
dwijen.vaidya@spt.pdpu.ac.in

Anirbid Sircar
Anirbid.sircar@spt.pdpu.ac.in

[1] School of Petroleum Technology, Pandit Deendayal Petroleum University, Gandhinagar, Gujarat, India

[2] Centre of Excellence for Geothermal Energy, Pandit Deendayal Petroleum University, Gandhinagar, Gujarat, India

1 Introduction

Monte Carlo simulation is a numerical demonstrating method named after the city of Monte Carlo in Monaco, where fundamental attractions are the gambling clubs. These clubs offer various games of chance like roulette wheels, slot machines, dice and card games (Sarimiento and Bjornsson 2007; Kalos and Whitlock 2007). There are different methods to estimate the maximum and minimum geothermal energy of a reservoir based on the laws of conservation of mass and energy. These methods used for resource assessment vary depending upon

Published online: 26 March 2018