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Study on the Influence of Hydrodynamic Conditions on CBM Wells Productivity

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Abstract CBM is collected by the process of dewatering through CBM wells. During the process of mining, coal bed should be treated as pressure-bearing moisture level during the water drawing, it can be divided into three stages: the early, the metaphase and the later. Water level and water yield in the producing well constantly affect the CBM output when only one well is in production. According to the data of gas output and water yield, dynamic water level and casing pressure by typical gas producing well in Bao De, E Dong area, establish the diagram of them separately, then proceed in linear regression simulation, analyzing the relationship of gas output and each mining dynamic parameter. From this we can know, gas output of coal bed has some positive correlation relationship, gas output has good effects when water level around the regular scope, good casing pressure controlling contributes to increasing gas output.
Keywords CBM, single well mining, water level, water yield, gas output

Introduction

According to the study both at home and abroad: CBM content, seam depth, coal bed structure, the fracture characteristics of CBM and so on are the main factors which affect the capacity of CBM wells(Yang 2008, Zhao et al. 2013, Kong et al. 2011). Gathering material of dynamic parameters in Bao De area, and then primarily, respectively researching the influence of gas output on water yield, casing pressure and dynamic water level. Water yield is an important parameter to react to CBM mining. An example to Bao De area, according to production process map of CBM wells in research area, CBM output mining well B07 is preferably chosen to analyze the relationship of gas output and water yield, dynamic water level and casing pressure.

Production mechanism of CBM wells

CBM single well mining can be divided into three conditions(Zhao et al. 2009, Wan et al. 2005, Li et al. 2008): 1) Forming stable depressurization funnel(contour of recharge and leaking recharge exist in coal bed). 2) Depressurization funnel is expanding continuously(confining boundary exists on one side or multi-side of coal bed). 3) Depressurization funnel is expanding continuously and then immobile(no leaking recharge and no contour of recharge or feed water boundary in coal bed).

Recovery process of CBM wells

For single well mining, it can be simply divided into the following three stages(Yang et al. 2013, Li et al. 2013):Early dewatering and decompression stage: during the initially productive stage of CBM wells, gas producing coal bed must be taken a lot of drawing and dewatering work to make the seam pressure falling rapidly. When the seam pressure drops to the desorption of supercritical pressure, CBM will be released from its gap (Benko et al. 2008). Medium-term stability of the production stage: during the stage of normal gas recovery in CBM wells, in the wake of continuously drawing and dewatering of coal bed, CBM production is increasing and stabilizing. When the gas output reaches to the highest value, the water yield of coal bed will gradually slow down.Later stage of gas declining:

when CBM is output up, gas desorption from coal seam will be gradually reduced, gas output and water yield will decrease as the continuity of mining operation until it's no longer producing gas (Li et al 2008). But, according to different drawing conditions, the CBM drawing process is also different, specific analysis must be made for specific field (Wan et al. 2005, Benko et al. 2008, Rice et al. 2000, Brinck et al. 2008, Ingelson et al. 2006, Vance et al. 2004).

Effects of hydrodynamic conditions on CBM production

In short, the factors affecting CBM production mainly are water yield and dynamic water level and casing pressure. Water yield is a direct factor for CBM production. In addition, for the process of coal bed dewatering to gassing is mainly controlled by the dynamic water level to keep casing pressure balanced, these two factors are inevitably linked. Scholars study through field experiments, casing pressure plays an important role in CBM production, maintaining the casing pressure can make the maximum inspiration from the seam.

Comprehensive analysis of water yield, dynamic water level and casing pressure to impact CBM production

Well B07: the beginning of the mining, as the dynamic water level falling, casing pressure was zero and water yield was increasing, while gas output was almost zero; in the middle and late, as the dynamic water level was gradually stable, casing pressure was also tending to be relatively stable, gas output and water yield changing frequently, but they were almost stable. During the period of mining: the relationship was not stable in the beginning, and later a weak positive correlation was displayed and the data were relatively stable (fig. 1).

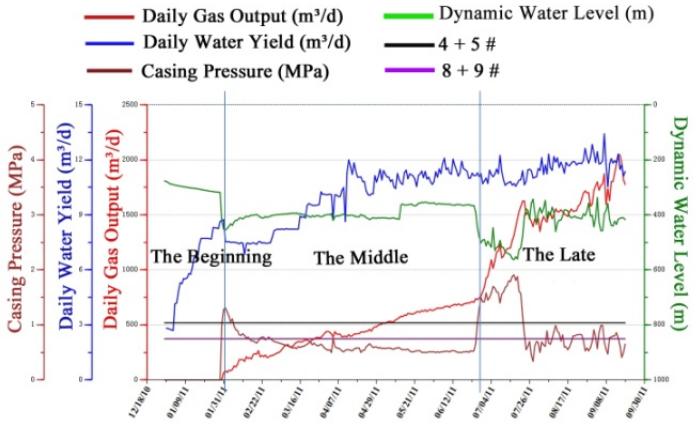

Fig. 1 *Well B07 mining curve*

By the subparagraph analysis of related gas output factors, there was no gas output or little gas output of every mining well during the early stage; in the middle and late, along with the dynamic water level maintaining, then casing pressure was maintained relatively stable, daily gas output and water yield were presenting a better related relationship, and gas output was maintained in a high level.

Analysis of water yield, dynamic water level and casing pressure to impact CBM production

(1) *CBM production impacts of dynamic water level and casing pressure*

The dynamic water level was always maintained around 400 m by well B07, casing pressure was among 0.5-0.9 MPa, the relationship was not obvious after artificial controlling, but in July, the dynamic water level was reduced, casing pressure was bigger, gas output had

mutation, then original dynamic water level was keep to maintain casing pressure, gas output was still increasing, so they have effects on gas output (fig. 2, fig. 3).

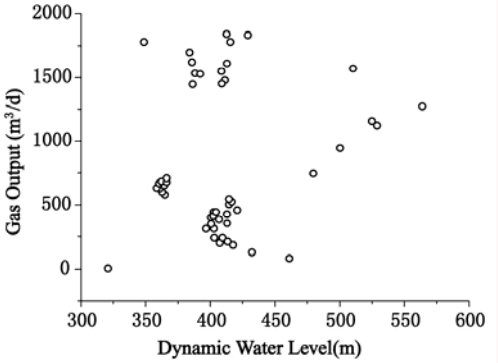

Fig. 2 *The relationship between gas output dynamic water level by well B07*

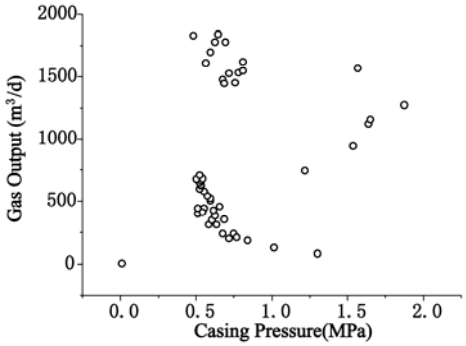

Fig. 3 *The relationship between gas output and and casing pressure by well B07*

Through the representative well of limited information, gas output process can be seen: by maintaining the dynamic water level reasonably, casing pressure is controlled with reason relatively, great help can be made for gas output increasing of CBM wells.

(2) ***CBM production impact of water yield***

When CBM wells are put into production, pumping decompression is used to mining. By drawing and draining away confined water in coal seam, coal seam pressure reduces, then gas from methane desorbs. Therefore, the study of coal bed methane water yield affects on CBM production is essential.

Well B07: water yield of the well was gradually increasing along with the mining process, there was very good positive functional correlation between gas output and water yield, during the stable gas output stage, water yield was maintained around 10-12 m^3/d, gas output reached 1800 m^3/d, there was obvious correlation between the two parameters (fig. 4). fig. 4 is a whole analysis figure of gas output and water yield by well B07, in order to better reflect the different mining stages of their relationship, the fitting relationship of gas output and water yield was further and piecewise analyzed:

The beginning mining of well B07: due to no gas output during the beginning, there won't be another analysis. The middle mining of well B07: the fitting line showed a high relationship, there was a higher relation between gas output and water yield, and with the water yield increasing, gas output was gradually increasing (fig. 5).The late mining of well B07: The points in fig. 6 are relatively discrete, the relationship of fitting line is not good, the relationship between gas output and water yield is not stable in the late, there is no good positive correlation.

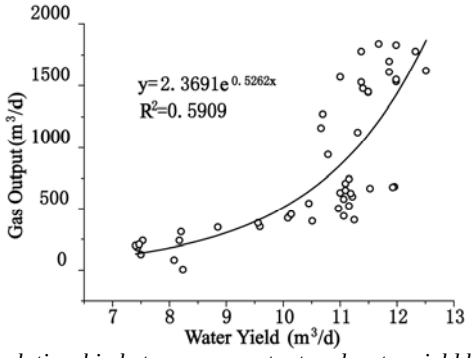

Fig. 4 *The relationship between gas output and water yield by well B07*

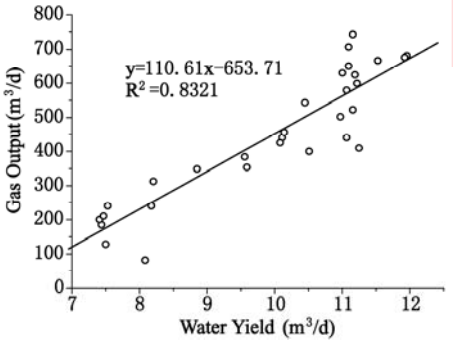

Fig. 5 *The relationship between gas output and water yield by well B07 in the middle*

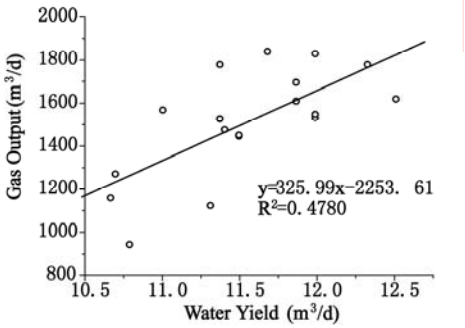

Fig. 6 *The relationship between gas output and water yield by well B07 in the late*

Analyzing the relationship between gas output and water yield of the representative well: 1. Comprehensive analysis of cases: in the area, there are some close links between gas output and water yield, good positive correlation is showed, and there is no accurate analysis of the relationship between gas output and water yield; 2. Segmentation analysis of cases: in the beginning, there are few wells which present positive correlation; in the middle, gas output and water yield show a high positive correlation; in the late, that when it reaches the stable stages of mining, gas output and water yield show a relatively stable trend and large output. It can be seen, in single well mining, water yield largely determines the capacity of CBM wells.

Conclusions

To single well mining, by regulating dynamic water level to control the casing pressure, when the casing pressure is relatively stable to a certain value (the most effective casing pressure which is beneficial to coal seam gas output), gas output reaches its maximum. Casing pressure of different mining wells should be based on actual production, and artificially controlling casing pressure is the key to improving gas output. Coal bed methane water yield has significant influence on CBM mining, and there is a good positive correlation with gas output.

In addition, using observed information to establish up the statistics relationship of water yield and gas output, and going on to be validated and perfect, the relationship of gas output and water yield can be produced reasonably, and show better guide meaning on CBM mining.

Acknowledgements

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