Support information 1:

FeAsO4 species:

Seting that the liquid-solid ratio of the leaching process is n, the free hydrogen ion in the leach solution after leaching is cH, that is, the pH of the leach solution is –lgcH. Since arsenic acid is a weak acid, there are:

ka1 = 6.2×10-3……（1）

ka2 = 1.2×10-7……（2）

ka3= 3.1×10-12……（3）

For the leaching of FeAsO4 species, seting that the content of MAsO4 in the dust is x (mass fraction), the molar mass of MAsO4 is M, the concentration of M3+ in the leachate is cM, and the concentrations of H3AsO4, H2AsO4-, HAsO42-, and AsO43- are y0, y1, y2, y3.

The dissolution of MAsO4 is:

Ksp(MAsO4) = K1……（4）

According to equations (1)(2)(3)(4), there are:

……（5）

……（6）

……（7）

……（8）

For incomplete leaching :

……（9）

Calculated according to equation (5) ~(9):

……（10）

At this point , then the concentration of sulfuric acid in the leachate should be:

……（11）

When , there are: ;

So for complete leaching:

……（12）

Calculated according to equation(5) (6)(7)(8)(12):

……（13）

The concentration of sulfuric acid in the leach solution should be：

……（14）

Support information 2:

ZnHAsO4 species:

Seting that the liquid-solid ratio of the leaching process is n, the free hydrogen ion in the leach solution after leaching is cH, that is, the pH of the leach solution is –lgcH. Since arsenic acid is a weak acid, there are:

ka1 = 6.2×10-3……（15）

ka2 = 1.2×10-7……（16）

ka3= 3.1×10-12……（17）

For the leaching of ZnHAsO4 species, seting that the content of MHAsO4 in the dust is x (mass fraction), the molar mass of MHAsO4 is M, the concentration of M2+in the leachate is cM, and the concentrations of H3AsO4, H2AsO4-, HAsO42-, and AsO43- are y0, y1, y2, y3.

The dissolution of MHAsO4 is:

Ksp(MHAsO4) = K1……（18）

According to equations (15)~(18), there are:

……（19）

……（20）

……（21）

……（22）

For incomplete leaching :

……（23）

Calculated according to equation (19) ~(23):

……（24）

At this point , then the concentration of sulfuric acid in the leachate should be:

……（25）

When , there are: ;

So for complete leaching:

……（26）

Calculated according to equation(19) (20)(21)(22)(26):

……（27）

The concentration of sulfuric acid in the leach solution should be：

……（28）

Support information 3:

PbHAsO4 species:

Seting that the liquid-solid ratio of the leaching process is n, the free hydrogen ion in the leach solution after leaching is cH, that is, the pH of the leach solution is –lgcH. Since arsenic acid is a weak acid, there are:

ka1 = 6.2×10-3……（29）

ka2 = 1.2×10-7……（30）

ka3= 3.1×10-12……（31）

For the leaching of PbHAsO4 species, seting that the content of MHAsO4 in the dust is x (mass fraction), the molar mass of MHAsO4 is M, the concentration of M2+ and SO42-in the leachate is cM and , and the concentrations of H3AsO4, H2AsO4-, HAsO42-, and AsO43- are y0, y1, y2, y3.

The dissolution of MHAsO4 and MSO4 are:

Ksp(MHAsO4) = K1……（32）

Ksp(MSO4) = K2……（33）

According to equations (29)~ (33), there are:

……（34）

……（35）

……（36）

……（37）

……（38）

Due to arsenate will be converted to sulfate:

……（39）

……（40）

So according to equation (34) ~(40):

……（41）

For incomplete leaching :

……（42）

At this point , then the concentration of sulfuric acid in the leachate should be:

……（43）

For complete leaching: ,

The concentration of sulfuric acid in the leach solution should be：

……（44）

Support information 4:

We here suppose that the MAsO4 substances in the original dust are arranged in order of leaching: M1AsO4, M2AsO4, M3AsO4, ... , MpAsO4, and when MiAsO4 is being leached, M1AsO4, M2AsO4, M3AsO4, ... Mi-1AsO4 has been completely leached. Seting that the concentration of MiAsO4 species in the leaching is c(MiAsO4)=ci (i=l,2,3,...,p), and the concentration of Mi3+ in the leachate is bi.

When MiAsO4 belongs to FeAsO4 species:

……（45）

Since y0, y1, y2 are relatively small, it can be simplified as:

……（46）

Then:

……（47）

……（48）

It can be seen that the leaching at this time is only related to MiAsO4, so the content of As in the dust is set to be ω (mass fraction), and when the concentration of Mi3+ in the leachate is bi, the leaching rate of As is η,：

……（49）

And due to the addition of hydrogen peroxide during the actual leaching process, it will cause some deviation in the calculation results. So a factor ε was introduced to correct the sulfuric acid concentration actual required. The correction factor ε can be approximated:

……（50）

is the leaching rate of arsenic by hydrogen peroxide leaching.

Then:

……（51）

……（52）

Support information 5:

We here suppose that the MHAsO4 substances in the original dust are arranged in order of leaching: M1HAsO4, M2HAsO4, M3HAsO4, ... , MpHAsO4, and when MiHAsO4 is being leached, M1HAsO4, M2HAsO4, M3HAsO4, ... Mi-1HAsO4 has been completely leached. Seting that the concentration of MiHAsO4 species in the leaching is c(MiHAsO4)=ci (i=l,2,3,...,p), and the concentration of Mi2+ in the leachate is bi.

When MiHAsO4 belongs to ZnHAsO4 species:

……（53）

Since y0, y1 are relatively small, it can be simplified as:

……（54）

Then:

……（55）

……（56）

It can be seen that the leaching at this time is only related to MiAsO4, so the content of As in the dust is set to be ω (mass fraction), and when the concentration of Mi3+ in the leachate is bi, the leaching rate of As is η,：

……（57）

And due to the addition of hydrogen peroxide during the actual leaching process, it will cause some deviation in the calculation results. So a factor ε was introduced to correct the sulfuric acid concentration actual required. The correction factor ε can be approximated:

……（58）

is the leaching rate of arsenic by hydrogen peroxide leaching.

Then:

……（59）

……（60）

Support information 6:

We here suppose that the MHAsO4 substances in the original dust are arranged in order of leaching: M1HAsO4, M2HAsO4, M3HAsO4, ... , MpHAsO4, and when MiHAsO4 is being leached, M1HAsO4, M2HAsO4, M3HAsO4, ... Mi-1HAsO4 has been completely leached. Seting that the concentration of MiHAsO4 species in the leaching is c(MiHAsO4)=ci (i=l,2,3,...,p), and the concentration of Mi2+ and SO42- in the leachate is bi and .

When MiHAsO4 belongs to PbHAsO4 species:

……（61）

Since y0, y1, y2 are relatively small, it can be simplified as:

……（62）

Because arsenate will be converted to sulfate:

……（63）

……（64）

is the total amount of non-PbHAsO4 species in M1AsO4, M2AsO4, M3AsO4, ..., MiAsO4。Due to y0, y1, y2, , it can be simplified as:

……（65）

Then:

……（66）

……（67）

It can be seen that the leaching at this time is only related to MiAsO4, so the content of As in the dust is set to be ω (mass fraction), and when the concentration of Mi3+ in the leachate is bi, the leaching rate of As is η,：

……（68）

And due to the addition of hydrogen peroxide during the actual leaching process, it will cause some deviation in the calculation results. So a factor ε was introduced to correct the sulfuric acid concentration actual required. The correction factor ε can be approximated:

……（69）

is the leaching rate of arsenic by hydrogen peroxide leaching.

Then:

……（70）

……（71）