**Supplementary Information**

**Comprehensive utilization of complex rubidium ore resources: Mineral dissociation and selective leaching** **of rubidium and potassium**

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**Table S1. Relationship between volume shrinkage of minerals and temperature**

|  |  |  |  |
| --- | --- | --- | --- |
| Volume shrinkage / % | Temperature / °C | | Temperature difference / °C |
| Raw ore | NaOH/raw ore ratio of 25wt% |
| 10 | 1177 | 1061 | 56 |
| 25 | 1307 | 1118 | 189 |
| 50 | 1359 | 1158 | 201 |
| 75 | 1424 | 1220 | 204 |

The separation of rubidium and potassium by solvent extraction has been systematically investigated previously by our group and the results were shown in Tables S2 and S3 [1‒2].

**Table S2. Operating conditions for the extraction of Rb from alkali leaching solution**

|  |  |  |
| --- | --- | --- |
| Stage | Parameter | Value |
| Extraction | Organic phase | 1 mol *t*-BAMBP |
| Contact time / min | 1.5 |
| O/A | 3:1 |
| Rb leaching rate / % | 98 |

Note: O/A―Organic phase/aqueous phase volume ratio.

**Table S3. Operating conditions for the extraction of K from raffinate of Rb**

|  |  |  |
| --- | --- | --- |
| Stage | Parameter | Value |
| Extraction | Organic phase | 1 mol *t*-BAMBP |
| Contact time / min | 1.5 |
| O/A | 3:1 |
| K leaching rate / % | 91.5 |
| Scrubbing | Aqueous phase | Deionized water |
| Contact time / min | 1.5 |
| O/A | 1:1 |
| Stripping | Aqueous phase | 1 mol HCl |
| Contact time / min | 2 |
| O/A | 1:1 |
| K leaching rate / % | 94 |

**Table S4. Potential economic value of the proposed process obtained from 1 t of rubidium ore**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Revenue** | **Product benefits** | | | |
| Product | Mass / kg | Price / (¥⋅kg‒1) | Benfits / ¥ |
| Rb | 1.6 | 900000 | 1440000 |
| K | 54.1 | 140 | 7574 |
| Zeolite A | 900 | 9 | 8100 |
| Total |  |  | 1455674 |
| **Cost** | **Reagent cost** | | | |
| Reagent | Dosage / kg | Price / (¥⋅kg‒1) | Cost / ¥ |
| NaOH | 1250 | 6.7 | 8375 |
| Al(OH)3 | 400 | 5 | 2000 |
| Total |  |  | 10375 |
| **Energy cost** | | | |
| Procedure | Energy consumption / kWh | Price / (¥⋅kWh‒1) | Cost / ¥ |
| Mineral dissociation | 18000 | 0.5 | 10500 |
| Leaching | 1500 |
| zeolite synthesis | 1000 |
| Filtering, drying | 500 |
| Total | 21000 |  | 10500 |
| **Other cost** | | | |
| Water | Water consumption / t | Price / (¥⋅t‒1) | Cost / ¥ |
| 100 | 200 | 20000 |
| Depreciation  of equipment |  |  | 600 |
| Maintenance  of equipment |  |  | 600 |
| Total |  |  | 21200 |
| **Total**  **profit** |  |  |  | 1413599 |

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**Fig. S1. SEM image and EDS images and spectra of the Slag-2.**



**Fig. S2. (a) XRD pattern and (b) SEM image of zeolite A.**

**References**

[1] Y. W. Lv, P. Xing, B. Z. Ma, Y. B. Liu, C. Y. Wang, W. J. Zhang, and Y. Q. Chen, Efficient Extraction of Lithium and Rubidium from Polylithionite via Alkaline Leaching Combined with Solvent Extraction and Precipitation, *ACS Sustainable Chem. Eng.*, 8(2020), No. 38, p. 14462.

[2] P. Xing, C. Y. Wang, L. Wang, B. Z. Ma, Y. Q. Chen, and G. D. Wang, Clean and efficient process for the extraction of rubidium from granitic rubidium ore, *J. Cleaner Prod.*, 196(2018), p. 64.