Table S1. Laboratory and field investigations on washing remediation of common used washing reagents, together with the recommendation index of heavy-metal removal ability, eco-friendliness and cost effectiveness.

| **Reagents** | **Removal efficiency of heavy metals (%)** | **References** | **Metals removal ability** | **Eco-****friendliness** | **Cost effectiveness** |
| --- | --- | --- | --- | --- | --- |
| **Cd** | **Cr** | **Cu** | **Ni** | **Pb** | **Zn** | **Hg** | **As** |
| Inorganic reagents | Acids | HCl | 95.5 [c] | 80.8 [c] | 79.3 [c]; 41-51 [d]; 93.7 [e] | 77 [f] | 88.7 [c]; 35-83 [d];43.5 [e] | 98 [c]; 65-97 [d] | 93 [a]; 15.2 [b] | 83.7 [a]; 64-92 [d]; 39.3 [e]; | [a] Alghanmi et al., 2016; [b] Lin, 2009; [c] Liu et al., 2010; [d] Moutsatsou et al., 2005; [e] Oh et al., 2015  | ☆☆☆ | ☆ | ☆☆☆ |
| H2SO4 | 81.9 [d] | 42 [b] | 38-68 [b]; 30 [c] | 42 [a]; 25 [b] | 6 [c]; <5.4 [d] | 58 [a]; 53 [b]; 78 [c] | / | 70 [a]; 80 [c] | [a] Ko et al., 2005; [b] Lin et al., 2012; [c] Moutsatsou, 2005; [d] Zhang, 2013  | ☆☆☆ | ☆ | ☆☆☆ |
| HNO3 | 76.6 [a] | / | 56.1 [b] | 36.5 [b] | 96.9 [b] | 73.7 [b] | 13.8 [a]; 0 [c] | 41 [b] | [a] Lin, 2009;[b] Oh et al., 2015; [c] Subires-Munoz et al., 2011 | ☆☆☆ | ☆ | ☆☆☆ |
| H3PO4 | 70 [d] | 69.9 [b] | / | 45 [a] | 59 [e] | 61 [a] | 18.9 [c] | 75 [a]; 23 [d] | [a] Ko et al., 2006; [b] Li et al., 2011; [c] Lin, 2009; [d] Wei et al., 2016; [e] Yang and Mosby, 2006 | ☆☆ | ☆☆ | ☆☆ |
| Alkali | NaOH | / | / | / | / | 1 [d] | 67 [c]; 18 [d] | 37.5 [b] | 90 [a]; 86.3 [d] | 1. [Jang](https://www.sciencedirect.com/science/article/pii/S0045653505000251%22%20%5Cl%20%22%21) et al., 2005; [b] Lin, 2009;
2. Moon et al., 2012; [c] Yang et al., 2009
 | ☆(As ☆☆☆) | ☆ | ☆☆ |
| Salts | FeCl3 | 25.6 [a],62.9 [c]; 88.3 [d] | 10 [b] | 63.4 [b]; 16.7 [c]; 70 [d] | 37.9 [b] | 22.8 [b]; 52.1 [c]; 78.7 [d] | 17.5 [b]; 30 [c]; 58.2 [d] | / | / | [a] Makino et al., 2006; [b] Yang et al., 2016; [c] Zhai et al., 2018: [d] Chen and Wu, 2018 | ☆☆ | ☆☆ | ☆☆ |
| CaCl2 | 19 [b]; 10 [c] | 5 [c] | 14 [c] | 15 [c] | 8 [c] | / | 9.4 [a] | / | [a] Lin, 2009; [b] Makino et al., 2006; [c] Yang et al, 2014  | ☆☆ | ☆☆ | ☆☆☆ |
| [Chelating](../AppData/Local/youdao/dict/Application/8.7.0.0/resultui/html/index.html%22%20%5Cl%20%22/javascript%3A) re[agent](../AppData/Local/youdao/dict/Application/8.7.0.0/resultui/html/index.html%22%20%5Cl%20%22/javascript%3A)s | Aminopolycarboxylic acids | EDTA | 76.3 [a]; 79.5 [b]; 66.8 [c]; 92 [e]; 96 [f]; 70 [g] | 72.5 [c]; 10 [e] | 92 [a]; 75.2 [b];90 [e]; 94 [f] | 21.3 [a] | 40.4 [a]; 86.7 [b]; 89 [e]; 99.6 [f]; 79 [g] | 46.8 [a]; 51.1 [b]; 87 [f]; 38 [g] | 28.6 [d]; 17 [f] | 80 [g] | [a] Begum et al., 2012; [b] Chen and Wu, 2018; [c] Gitipour et al., 2016; [d] Lin, 2009; [e] Ramamurthy and Schalchian, 2013; [f] Wasay et al., 2001; [g] Voglar and Lestan, 2012 | ☆☆☆ | ☆☆ | ☆ |
| DTPA | 98 [a] | / | 90 [a] | / | 92 [a]; 5 [c] | 85 [a] | 23.1 [b] | / | [a] Wasay et al., 2001; [b] Lin, 2009; [c] Neilson et al., 2003 | ☆☆ | ☆☆ | ☆ |
| EDDS | 52 [a]; 22.5 [d] | 16.3[b] | 67.3 [a]; | 17.6 [a]; | 21.8 [a]; 83.7 [d] | 26.9 [a]; 42.5 [d] | / | 89.9 [c](pH>10) | [a] Begum et al., 2012; [b] Li et al., 2011; [c] Li and Pan, 2015; [d] Wang et al., 2016 | ☆☆ | ☆☆☆ | ☆ |
| IDSA | 46 [a]; 91 [b] | / | 62.8 [a]; 46-91 [b] | 18.4 [a]; 28-80 [b] | 7.8 [a]; 65-95 [b] | 25.4 [a] | / | / | [a] Begum et al., 2012; [b] Mohamed et al., 2013 | ☆☆ | ☆☆☆ | ☆ |
| GLDA | 61.9 [a]; 60.5 [d]; 95 [c] | 0.9 [b] | 60.6 [a]; 47.6 [b]; 90 [c] | 18.4 [a] | 14.7 [a]; 88.6 [d]; 83 [c] | 30.1 [a]; 81 [c]; 38.1 [d] | / | 7.3 [b] | [a] Begum et al., 2012; [b] Hartley et al., 2014; [c] Jiao, 2017; [d] Wang et al., 2016 | ☆☆ | ☆☆☆ | ☆ |
| NTA | 42.4 [c] | / | 54.3 [c]; 38-88 [b] | 23-80 [b] | 41.6 [c]; 70-94 [b] | 9.9 [c] | / | 94.1 [a] | [a] Li and Pan, 2015; [b] Mohamed et al., 2013; [c] Yang et al., 2019 | ☆☆ | ☆☆ | ☆ |
| Natural low molecular organic acids | Citric acid | 65.4 [a]; 59.5 [g] | 25.7 [b]; 35.1 [d]; 58.8 [g] | 54.1 [a]; 26.3 [b]; | 33 [b] | 35[a]; 7.9[b] | 59.1 [a]; 21.6 [b] | 0.08 [c]; 30.3 [d] | 88.7 [f] (pH<3) | [a] Chen and Wu, 2018; [b] Gan et al., 2012; [c] Jia et al., 2018; [d] Jiang et al., 2012; [e] Li et al., 2011; [f] Li and Pan, 2015; [g] Tao, 2013 | ☆☆ | ☆☆☆ | ☆☆ |
| Oxalic | 70 [d]; 12 [e] | 24.8 [a]; 47 [e]; 10.2 [f] | 55.1 [a]; 2.8 [f] | 47.5 [a];9.8 [f] | 7.3 [a]13.6 [f] | 29.3 [a]; 2.5 [f] | 27.3 [b] | 3.7-60.5 [c]; 22 [d] | [a] Gan et al., 2012; [b] Jiang et al., 2012; [c] Lee et al., 2017; [d] Wei et al., 2016; [e] Tao, 2013; [f] Yang et al., 2016 | ☆☆ | ☆☆☆ | ☆☆ |
| [Tartaric](../AppData/Local/youdao/dict/Application/8.7.0.0/resultui/html/index.html%22%20%5Cl%20%22/javascript%3A) | 46 [d]; 19.9 [e] | 33 [d] | 30.2 [e] | 28.3 [e] | 16.4 [e] | 26.6 [e] | 0.07 [a]; 22.4 [b] | 15 [c] | [a] Jia et al., 2018; [b] Lin, 2009; [c] Liu et al., 2014; [c] Tao, 2013; [d] Wuana et al., 2010 | ☆☆ | ☆☆☆ | ☆☆ |
| Acetic | 70.6 [a]; 58-100 [c] | 0.9 [b]; 6-27 [c] | 4.8 [b]; 1-14 [c] | 23.3 [a]; 12.6 [b]; 6-62 [c] | 42.2-100 [a]; 3.3 [b];55-100 [c] | 8.1 [b]; 44-100 [c] | 1 [c] | 5 [c] | [a] Gzar et al., 2014; [b] Gan et al., 2012; [c] Reddy et al., 2010 | ☆☆ | ☆☆☆ | ☆☆ |
| [Surfactant](../AppData/Local/youdao/dict/Application/8.7.0.0/resultui/html/index.html%22%20%5Cl%20%22/javascript%3A)s | Synthetic surfactants | SDBS | 30.1 [a] | 75.1 [a]; 17.6 [b] | / | / | / | / | / | / | [a] Chen and Fu, 2012; [b] Li et al., 2011 | ☆ | ☆ | ☆ |
| SDS | 75.8 [a]; 48 [c]; 50 [d] | 29.8 [a]; 10.2 [e] | 19 [c]; 15 [d]; 2.8 [e] | 9.8 [e] | 13 [c]; 12 [d]; 13.6 [e] | 2.5 [e] | 0.06 [b] | / | [a] Chen and Fu, 2012; [b] Jia et al., 2018; [c] Ramamurthy and Schalchian, 2013; [d] Yang et al., 2016  | ☆ | ☆ | ☆ |
| Tween | 37.1 | 61.2 | / | / | / | / | / | / | Chen and Fu, 2012 | ☆ | ☆ | ☆ |
| Triton X-100 | 3 [b]; 52.8 [c] | / | 6 [b] | 45.2 [c] | 2 [b] | / | 32.8 [a] | / | [a] Lin, 2009; [b] Ramamurthy and Schalchian, 2013; [c] Wang and Mulligan, 2004 | ☆ | ☆ | ☆ |
| Biosurfactants | Rhamnolipids | 92 [a]; 53.8 [b]; 61.7 [c]  | 92 [a] | 88 [a]; 63.2 [b]; | 78 [a]; 51 [c]; | 88 [a]; 23.1 [b] | 44.7 [b] | / | 34.4 [b] | [a] Juwarkar et al., 2007; [b] Li et al., 2015; [c] Wang and Mulligan, 2004 | ☆☆ | ☆☆☆ | ☆ |
| Cyclodextrin | 28 [c] | 11.5 [a]; 20 [c] | / | 13.4 [c] | 14.2 [b]; 40 [c] | / | / |  | [a] Li et al., 2011; [b] Neilson et al., 2003; [c] Ye et al., 2015 | ☆☆ | ☆☆☆ | ☆ |
| Sophorolipid | 46 [b]; 79.8 [d] | 18 [b]; 65.4 [c] | 3.3 [a]; 35 [b]; 35.9 [c] | 65.3 [c] | 17 [b]; 32.1 [c]; 30.3 [d] | 48.9 [c] | / | 11.7 [a] | [a] Arab and Mulligan, 2018; [b] Chen et al., 2017; [c] He et al., 2017; [d] Qi et al., 2018 | ☆☆ | ☆☆☆ | ☆ |
| Saponin | 41.6 [c]; 95.1 [e]; 45.6 [f] | 4 [c]; 37.6 [d] | 36 [a]; 43.9 [e];24.4 [f] | / | 47 [a]; 83.5 [e]; 17.6 [f] | 18 [a]; 20.3 [e]; 19 [f] | / | 22.2 [b] | [a] Maity et al., 2013; [b] Gusiatin, 2014; [c] Tao, 2013; [d] Yan et al., 2015; [e] Zhan et al., 2012; [f] Zhu et al., 2010  | ☆☆ | ☆☆☆ | ☆ |
| Tannic acid  | 59. 1 [c] | / | 63 [a] | / | 63 [a] | 48 [a] | / | 38 [b]; 38.2 [c] | [a] Gusiatin, 2014; [b] Gusiatin et al., 2017; [c] Wu et al., 2016  | ☆☆ | ☆ | ☆ |
| Lipopeptid | 44.2 | / | 26.2 | 32.2 | 40.3 | 32.1 | / | / | Singh and Cameotra, 2013  | ☆☆ | ☆☆☆ | ☆ |
| Compound chemical reagents | Dissolved organic matter | 90.1 [a]; 80 [c]; 86.88 [e] | 23.55 [f] | 72 [b] | 43.84 [e] | 18.6 [a]; 8.7 [b] | 15.2 [a]; 50.5 [b] | / | 30 [d] | [a] Can et al., 2018; [b] Kulikowska et al., 2015; [c] Liu and Chen, 2013; [d] Rashad et al., 2013; [e] Zhang et al., 2019; [f] Zou et al., 2019 | ☆☆ | ☆☆☆ | ☆☆☆ |

Remarks: i) ☆ in the table means the recommendation index, the more ☆, the stronger heavy-metal removal ability, the more eco-friendly, and the more cost effectiveness. ii) the metals removal ability is duduced from the removal efficiency of heavy mteals based on laboratory and field investigations. iii) the eco-friendliness is also duduced from the reference studies. iv) the prices of the washing reagents come from internet, for example, http://www.100ppi.com/.

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