

TABLE 22-continued

XPS results for cleaning efficiency				
Sample	Treatment	Aluminum Metal Content (%)	Carbon Content (%)	Alu- minum/ Carbon Ratio
Can 7	1 Minute Control	17.72	31.39	0.56
	Water 45 kg + Citrate 500 g + Non-ionic Surfactant 25 g			
Can 8	1 Minute Treatment	39.13	18.30	2.14
	Water 45 kg + Citrate 500 g + Non-ionic Surfactant 25 g + Nylon polymeric particles 10 kg			

[0200] The data shown in Table 22 illustrates the results of XPS analysis for the amount of aluminum metal and carbon on the can surface following the various treatments. The amount of carbon can serve as a surrogate measure for the presence of contaminants (e.g. smut). A higher aluminum/carbon ratio as indicated in Table 22 thus indicates that more aluminum is present on the can surface and that more carbon or contaminant residue has been removed. The cans treated with the polymeric particles (i.e. cans 4, 6 and 8) showed a significant increase in aluminum/carbon ratio compared to the controls (i.e. cans 1, 2, 3, 5 and 7) demonstrating a dramatically improved cleaning efficiency.

TABLE 23

XPS results for cleaning efficiency			
Sample	Treatment	Nitrogen Content (%)	Sodium Content (%)
Can 1	Control Can - No Treatment	0.93	2.75
Can 2	Can Treated With Water Only	0.83	0.40
Can 3	5 Minute Control	1.47	3.56
	Water 45 kg + Citrate 500 g + Non-ionic Surfactant 25 g		
Can 4	5 Minute Treatment	0.0	0.39
	Water 45 kg + Citrate 500 g + Non-ionic Surfactant 25 g + Nylon polymeric particles 10 kg		
Can 5	2 Minute Control	0.45	2.21
	Water 45 kg + Citrate 500 g + Non-ionic Surfactant 25 g		
Can 6	2 Minute Treatment	0.0	0.18
	Water 45 kg + Citrate 500 g + Non-ionic Surfactant 25 g + Nylon polymeric particles 10 kg		
Can 7	1 Minute Control	0.35	4.03
	Water 45 kg + Citrate 500 g + Non-ionic Surfactant 25 g		
Can 8	1 Minute Treatment	0.0	0.0
	Water 45 kg + Citrate 500 g + Non-ionic Surfactant 25 g + Nylon polymeric particles 10 kg		

[0201] The data in Table 23 (above) illustrates the results of XPS analysis for the amounts of other impurities on the aluminum surface, namely nitrogen and sodium. The cans treated with the polymeric particles (i.e. cans 4, 6 and 8) indicated effective removal of nitrogen and sodium. In comparison, the controls showed relatively high levels of these impurities. This demonstrated a dramatically improved cleaning efficiency for the cans treated with the polymeric particles (i.e. cans 4, 6 and 8) which again indicated that it was the polymeric particles used that were the essential cleaning component.

Experiment 8

Aluminum Cleaning & Oxide Removal Using an Apparatus Fitted with Pumping Means

[0202] The ingredients were Mulan™ 200S (25.0 g), a non-ionic surfactant supplied by Christeys, Bradford, UK and the citrate component consisted of trisodium citrate dihydrate (500.0 g) supplied by VWR, Loughborough, UK. The polymeric particles were Polyester (PET) supplied by Teknor Apex, UK, in the form of beads. The mass of the polymeric particles used in the apparatus was 10 kg. Uncoated aluminum metal cans grade ALJSC60ML63X15 were supplied by Invopak UK Ltd. Hyde, Cheshire.

[0203] XPS analysis was carried out with an Axis Ultra DLD, using an Al K α monochromated radiation source. An overall survey scan was taken initially, followed by detailed scans of the main peaks for the elements identified, using a pass energy of 160 eV and 20 eV respectively. The measured data was fitted using Casa XPS (Casa Software Ltd, UK), using relative sensitivity factors based upon the scheme where C1s=1, and adjusted to correct for any minor charging using the aliphatic carbon peak at 285 eV. Each sample was measured in 2 places.

[0204] In order to carry out the experiments, the treatment liquor was added to a vessel containing a pump. The treatment liquor consisted of the polymeric particles (of total mass 10 kg) and tap water (45 kg) and the further formulation components as shown in Table 24. Aluminum cans were fixed to a metal rod which was fixed by means of a clamp. Each can was inserted into the vessel containing the treatment liquor. The cans were then subjected to contact with the pumped liquor for a period of 1, 2 and 5 minutes at a temperature of 22° C., ensuring contact between the can and the treatment liquor. After treatment, the cans were washed with Milli-Q™ water and isopropanol and subjected to XPS analysis.

TABLE 24

Sample Details And Formulation Components.	
Sample	Formulation components/treatment
Can 1	Control Can - No Treatment
Can 2	Can Treated With Water Only
Can 3	5 Minute Control
	Water 45 kg + Citrate 500 g + Non-ionic Surfactant 25 g
Can 4	5 Minute Treatment
	Water 45 kg + Citrate 500 g + Non-ionic Surfactant 25 g + PET polymeric particles 10 kg
Can 5	2 Minute Control
	Water 45 kg + Citrate 500 g + Non-ionic Surfactant 25 g
Can 6	2 Minute Treatment
	Water 45 kg + Citrate 500 g + Non-ionic Surfactant 25 g + PET polymeric particles 10 kg
Can 7	1 Minute Control
	Water 45 kg + Citrate 500 g + Non-ionic Surfactant 25 g
Can 8	1 Minute Treatment
	Water 45 kg + Citrate 500 g +