CC 5/14

CCK - why delay?

DA

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS 77058

REPLY TO ATTN OF: DC71/5/M09/71 (W&W)

JUN 8 1971

MEMORANDUM

TO: PA/Apollo Program Manager

FROM: DA/Director of Medical Research and Operations

SUBJECT: Excessive Nickel Content in Apollo 14 Potable Water

The presence of an inordinate quantity of ionic nickel has been indicated by the chemical analysis of a postflight potable water sample taken from the Apollo 14 Command Module. The particular sample in reference is that taken from the hot water port in which the nickel ion concentration was found to be 6.0 mg/l. The nickel ion concentration in the cold water port at this time was found to be 0.18 mg/l. Both samples were collected and analyzed in an identical manner. Astronauts consume approximately 40 percent of their total daily water ration from the hot water port and 60 percent from the cold water port (drink gun). If the "effective nickel concentration" is calculated as per PF-SPEC-1C (60%*0.18 + 40%*6.0), the value for ionic nickel becomes 2.51 mg/l. This level significantly exceeds the prescribed limit of 1.0 mg/l as defined in the above specification.

Preflight and postflight water samples from the hot water port have always shown the presence of ionic nickel in varying amounts (see attached table), but have remained below the maximum permissible effective limit of 1.0 mg/l concentration. It is our opinion that a significant elevation of ionic nickel, such as has been found in the Apollo 14 CM potable water, represented a potential hazard to the crew. The medical literature bearing on the subject of nickel toxicity supports this position.

It is recommended that the cause of this high level of nickel be determined and eliminated prior to the next flight. It is noted that sodium nitrate, a corrosion inhibitor, was used for the first time in the Apollo 14 CM potable water. Although qualification testing, associated with the addition of sodium nitrate, did not show any significant nickel ion buildup, it is suggested that the sodium nitrate may be affecting the nickel problem. This is premised because sodium nitrate was not used in any of the CM vehicles prior to Apollo 14 and none of these vehicles experienced excessive nickel concentrations. The nickel concentration probably results from leaching/corrosion of the nickel alloy

brazing in the CM hot water heater. Another possible cause of the elevated nickel content could be excessive brazing material in the Apollo 14 hot water heater. However, if this was the case, then the preflight samples should have shown elevated levels of nickel also and they did not (see attached table). Rather, the preflight sample levels were not dissimilar to those experienced in previous spacecraft. While the preflight data do not support this theory, it is felt that the heater should be inspected to verify that excessive brazing was not used.

In summary it is recommended (1) that Apollo 14 water heater be examined to determine if excessive amounts of brazing were used and (2) that consideration be given to eliminating the use of sodium nitrate in the CM potable water.

We are concerned with this problem and will cooperate in the fullest extent possible in resolving it. Our contact for the effort in working this problem is Mr. Richard Sauer/DC71, X5056.

Richard S. Johnston for

Charles A. Berry, M.D.

Enclosure

cc:
EC/R. E. Smylie
EC3/F. H. Samonski
EC3/D. F. Hughes

DC71/RLSauer:lmr:5/20/71:5056
Rewritten:DC71/RLSauer:af:6/2/71:5056

NICKEL CONCENTRATION, mg/l

| | Ground Support Equipment | Hot Water Port | | Drink Gun | | Waste Tank | |
|---|---|---|---|---|---|---|---|
| | | Preflight | Postflight | Preflight | Postflight | Preflight | Postflight |
| Apollo 14 | 0.03 | 0.05 | 6.0 | 0.05 | 0.18 | | 1.25 |
| Apollo 13 | <0.03 | 0.3 | | 0.04 | 0.03 | | 0.08 |
| Apollo 12 | 0.03 | 0.2 | 0.76 | 0.03 | 0.10 | | 0.02 |
| Apollo 11 | <0.03 | 0.3 | 0.58 | <0.03 | 0.03 | | 0.15 |
| Apollo 10 | <0.03 | 0.05 | 0.34 | 0.03 | 0.05 | 0.08 | 0.08 |
| Apollo 9 | <0.02 | 0.4 | 2.97 | <0.05 | 1.12 | | |