2000 NASA Aerospace Battery Workshop

Recent Developments in Silver/Zinc Rechargeable Cell Studies

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NAVSEA Crane

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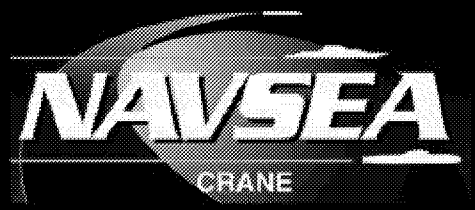
Recent Developments In Silver/Zinc Rechargeable Cell Studies



Introduction – History of cellophane and sausage casing model cell studies.

Objective – Reduce number of layers of separation on cathode while maintaining cell performance.

Experimental – Five cell sets of thirteen cells each. Eight cycle life and five wet life. Periodic cell removal for design performance analysis.

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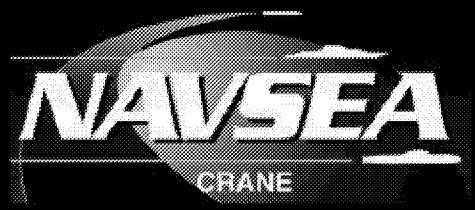

Cell Separation Configurations;

Set 1 – Reference standard set – six layer of 1-mil untreated Flexel clear cellophane provided by Yardney Technical Products (YTP), cathode wrap.

Set 2 – Reference standard set – six layers of 1-mil Flexel cellophane silver-treated (C-19) by YTP, cathode wrap.

Set 11 – Double layer SC set – one layer of 1-mil tubular SC followed by one layer of 2-mil PVA, followed by two layers of 2.3-mil SC from split SC tubing, cathode wrap.

Set 12 – Single layer SC set – one layer of 1-mil tubular SC followed by one layer of 2-mil PVA, followed by one layer of 2.3-mil SC from split SC tubing, cathode wrap. Cells were shimmed with cell case plastic to provide constant internal stack pressure vs. set 1.

Set 13 – Split wrap set – three layers of 1-mil Flexel cellophane silver-treated (C-19) by YTP, cathode wrap, plus three layers anode wrap. (The anodes were wrapped in a split L-configuration to seal the bottom of the anodes.)

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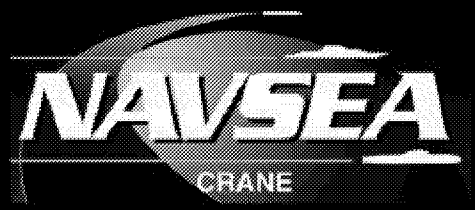

- Results and Discussion
  - Discharge capacity comparisons
  - Silver migration comparisons

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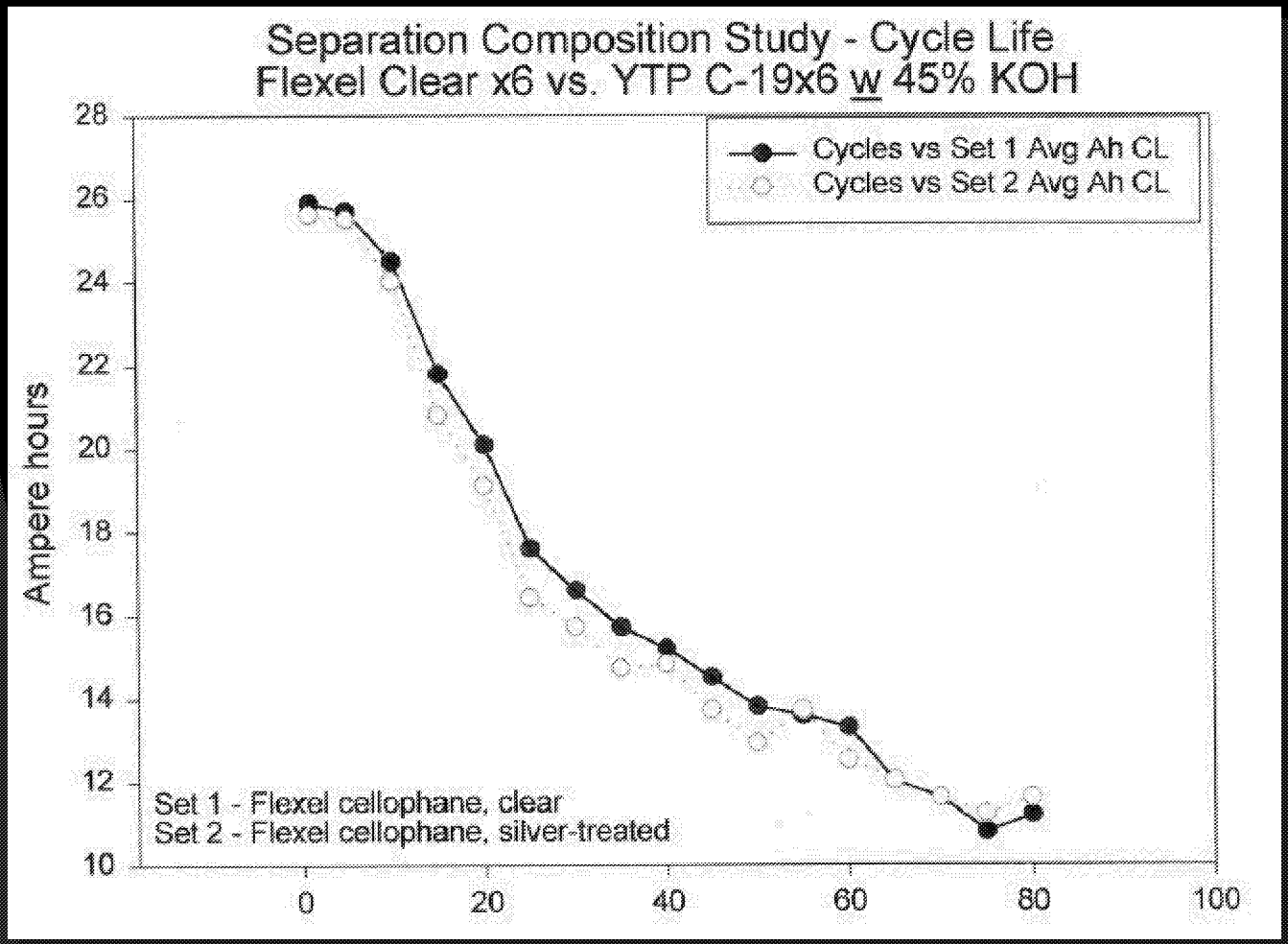
Cycle life data show approx. equivalent performance.



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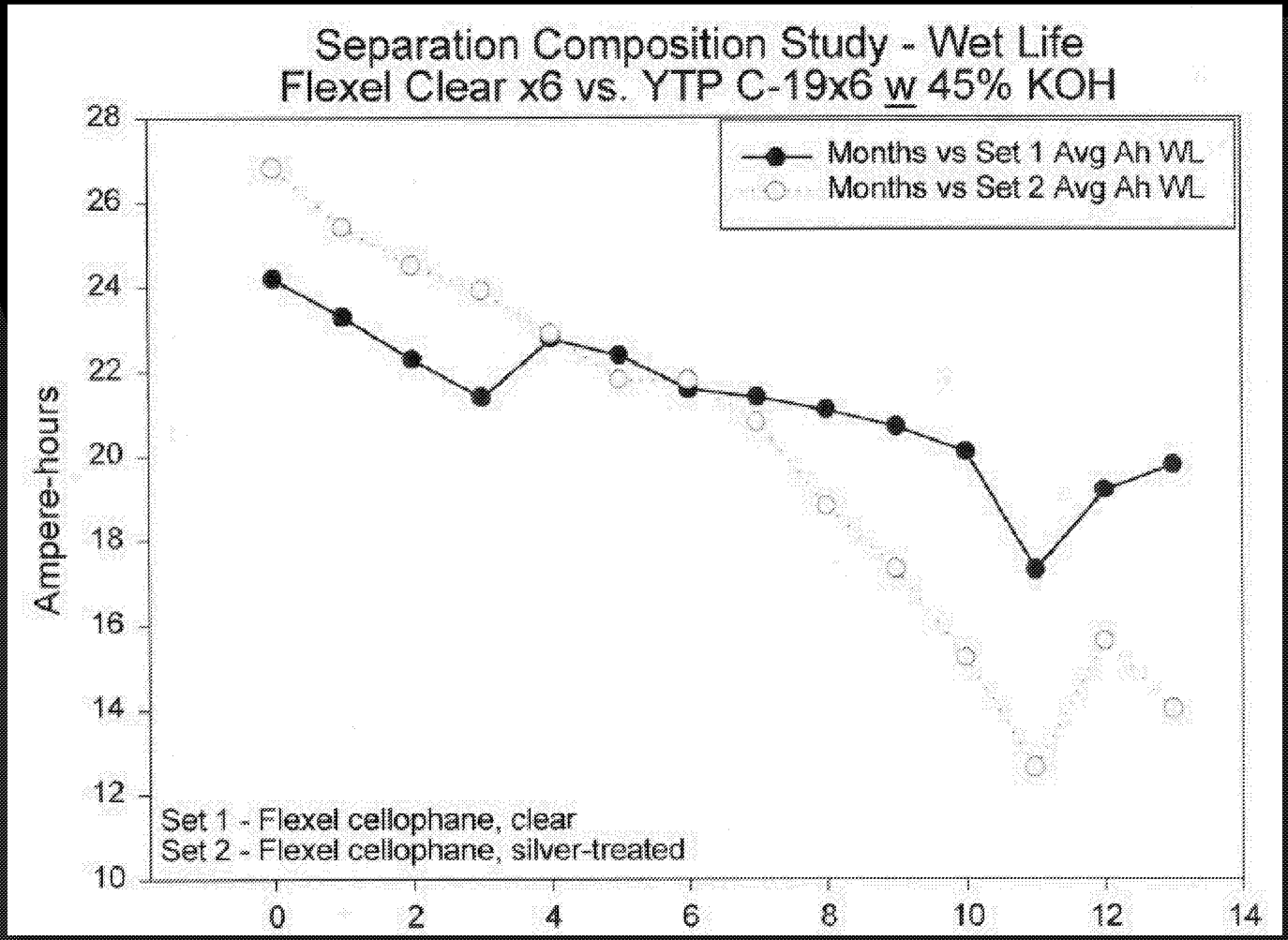
All but one of the clear Flexel wet life cells shorted out by the tenth month, while none of the C19 cells shorted, so comparison is flawed.



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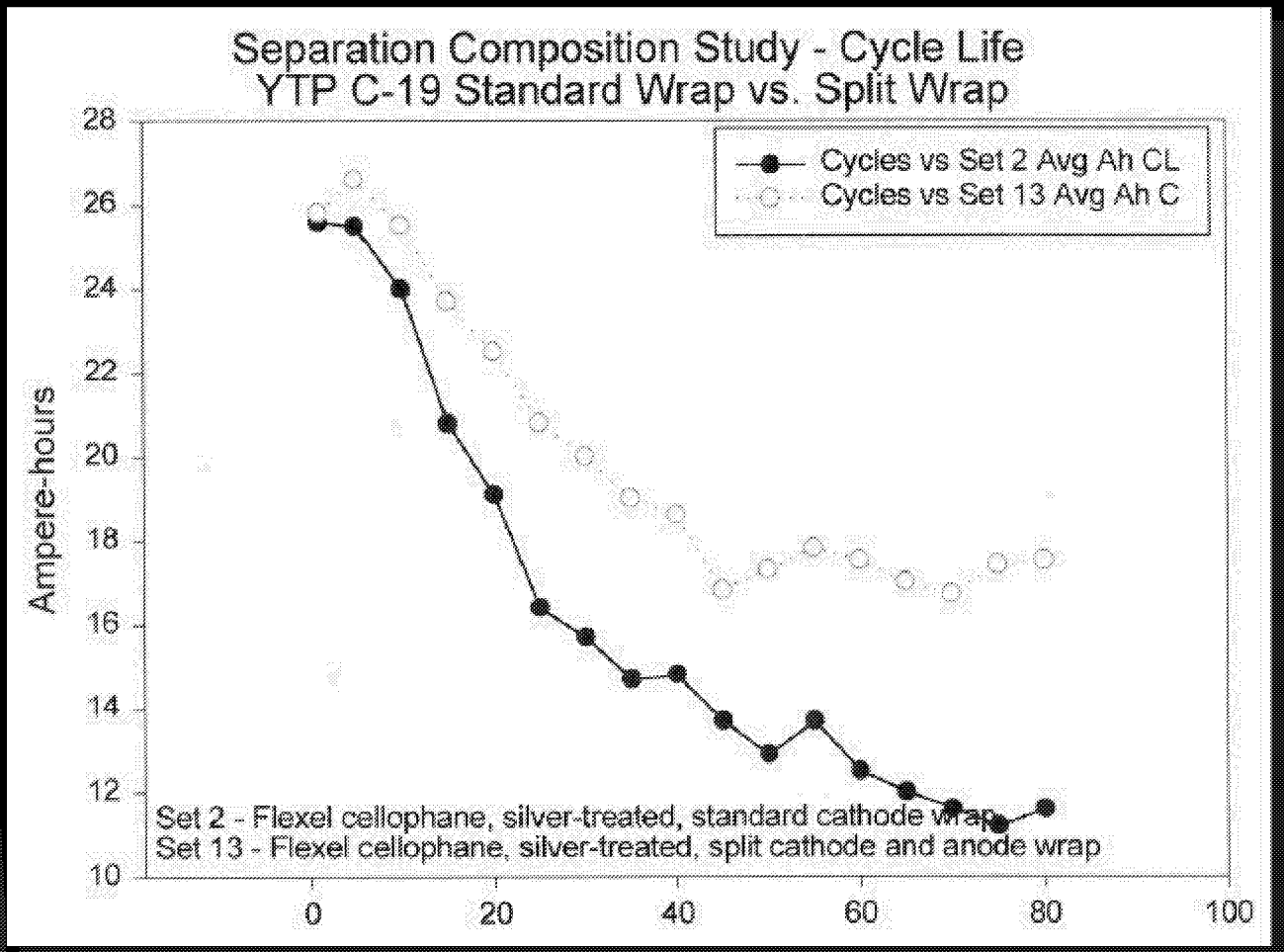
Cycle life data show a significant performance advantage for split wrap.



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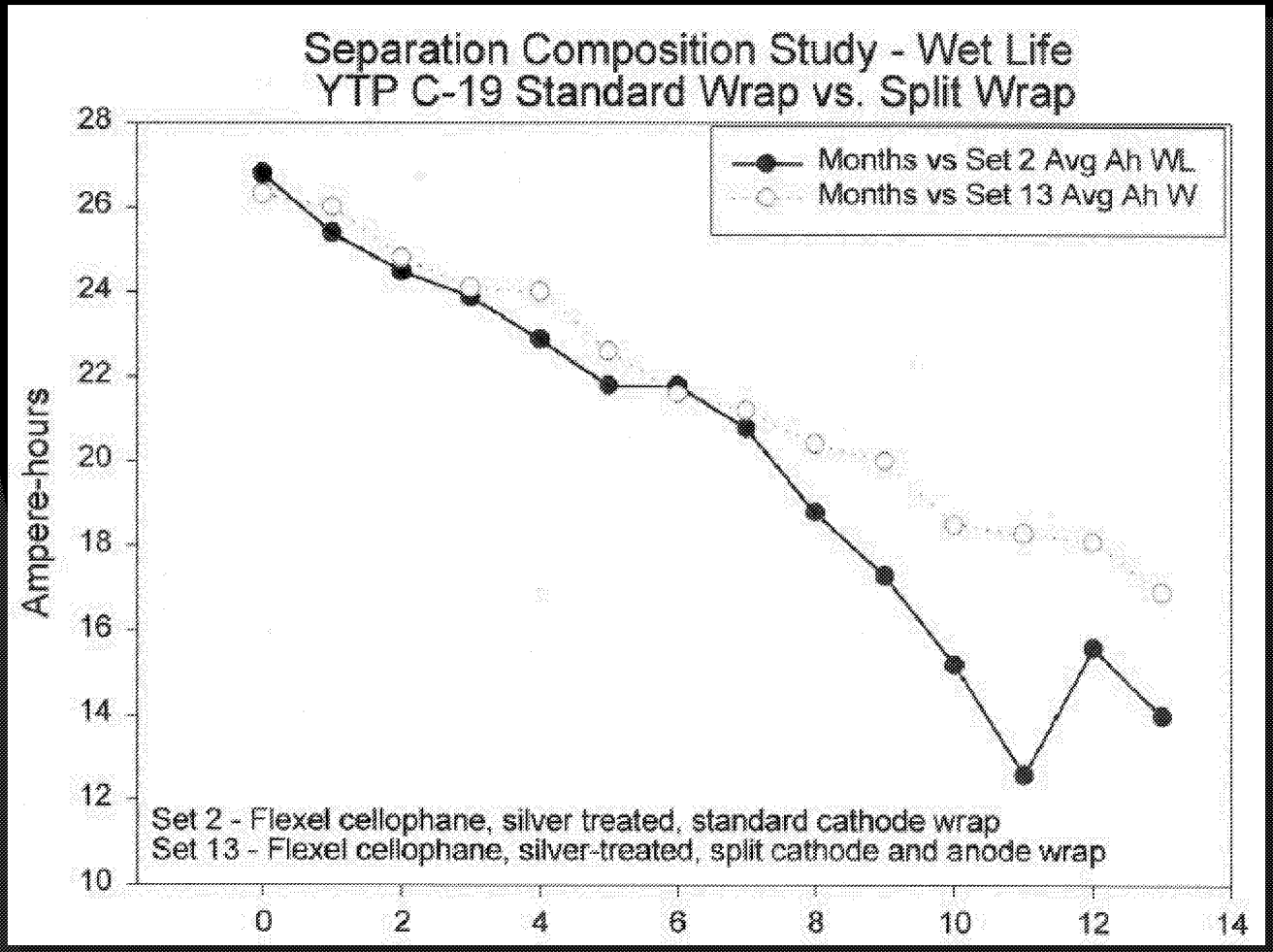
Wet life data also show a significant capacity advantage for split wrap.



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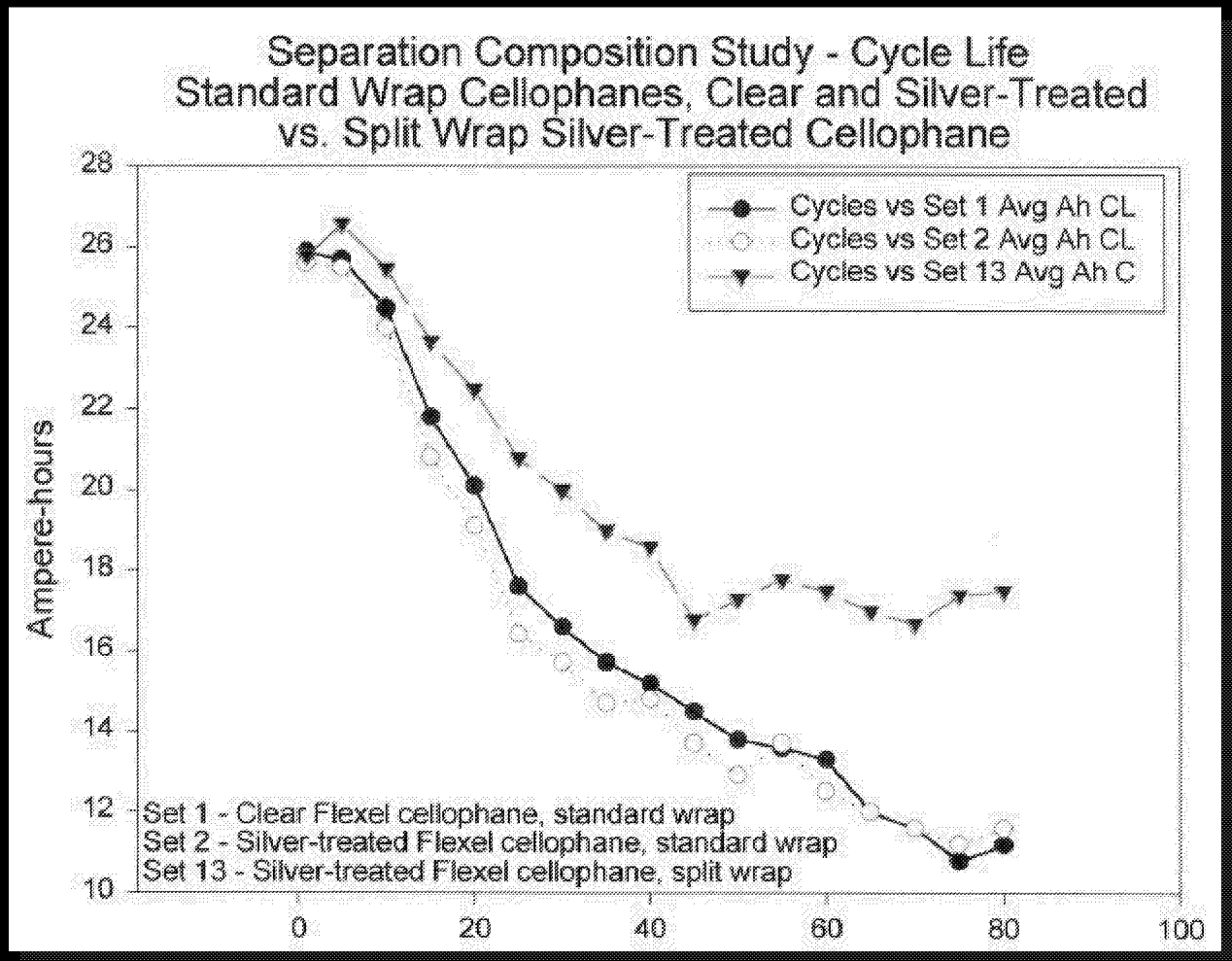
Combined plots for split wrap vs. both standard wraps in cycle life. The split wrap performance is clearly superior.



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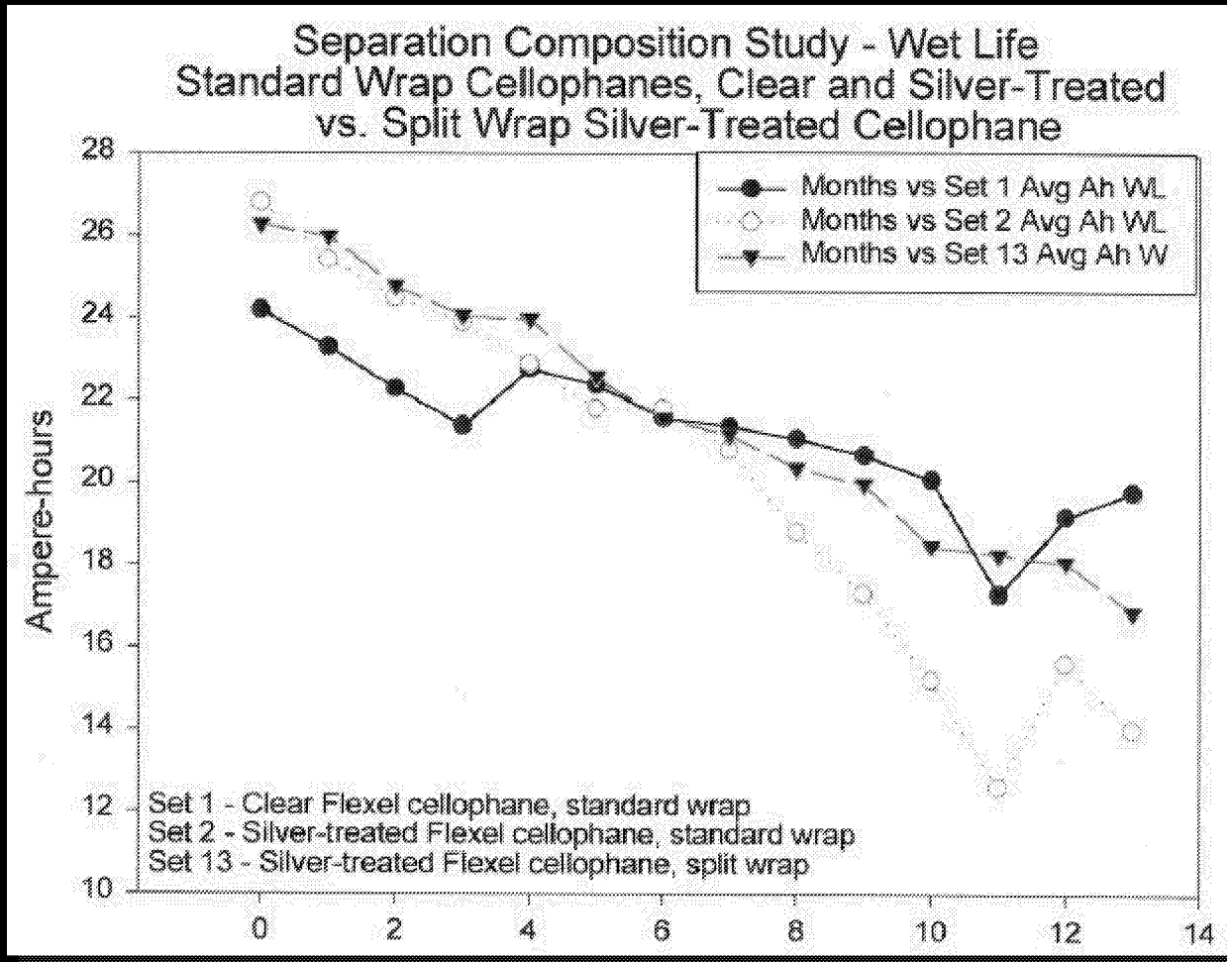
The Set 1 cells shorted out beginning at the 6th month, while no cells in Sets 2 and 13 shorted at all, so the discharge capacity averages do not reflect the actual performance adequately. Sets 2 and 13 were actually superior to Set 1, overall.



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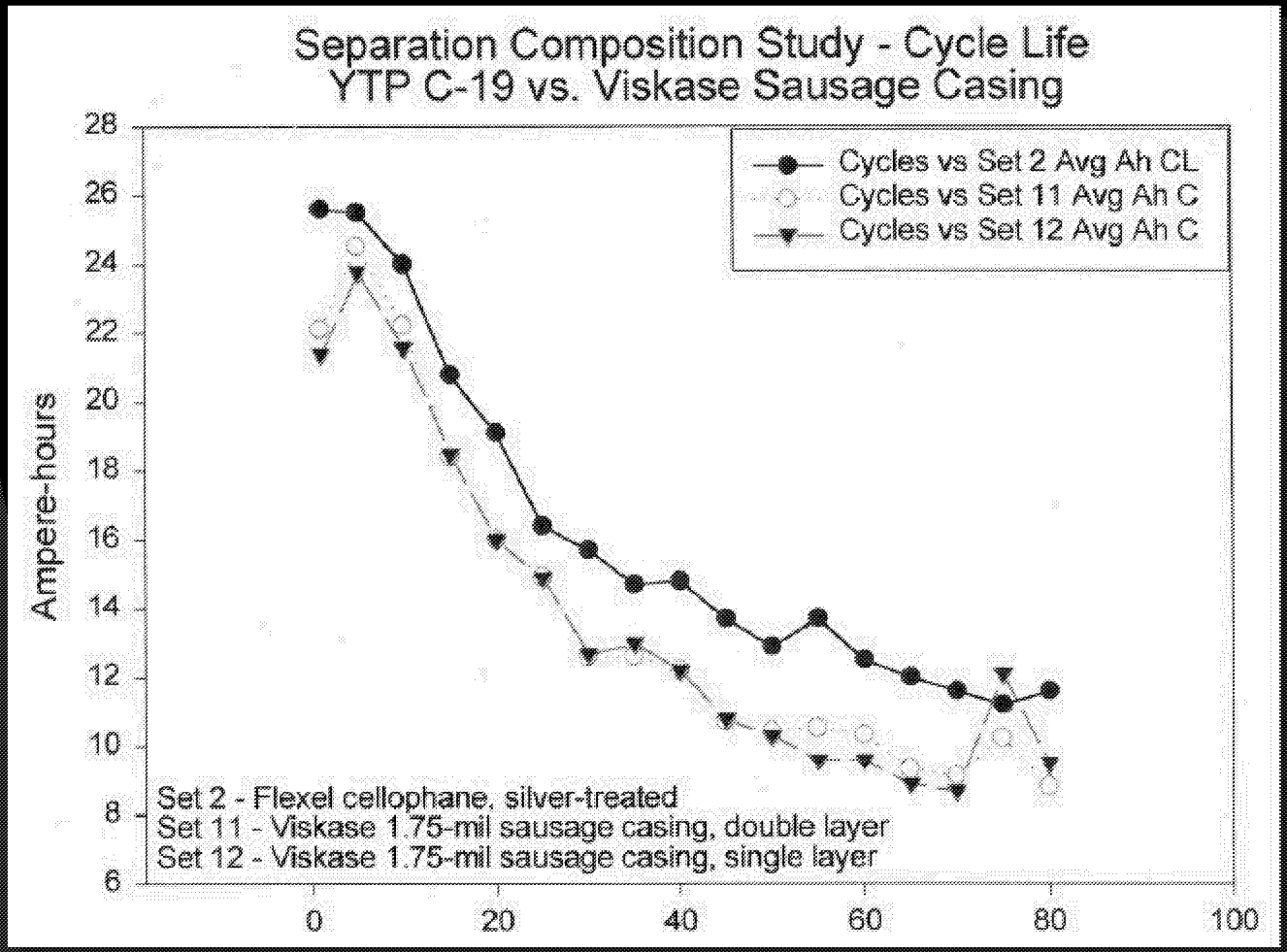
Cycle life data for the two SC configurations exhibit slightly lowered capacity vs. C19, but no shorts occurred in any Set.



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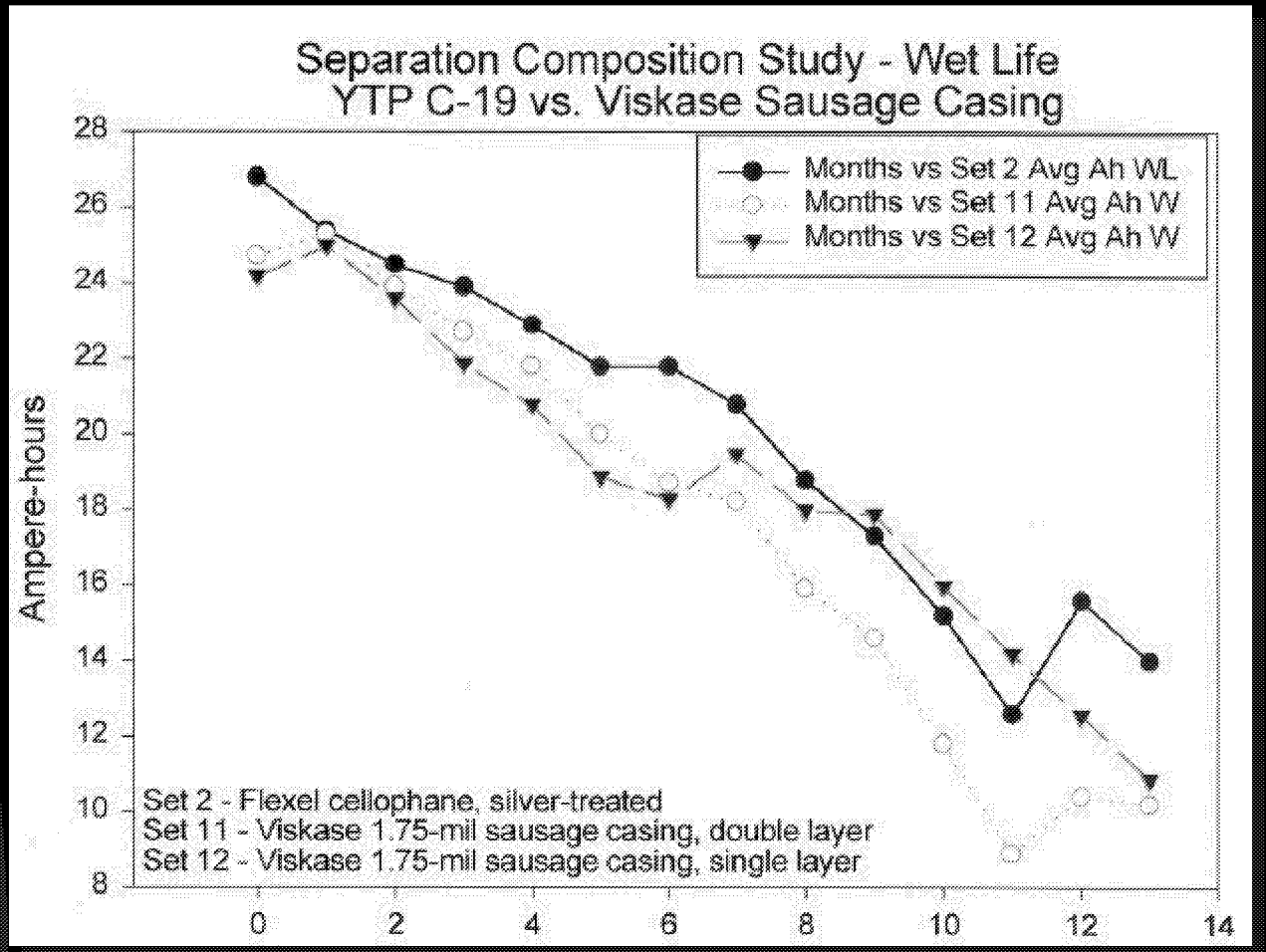
Wet life data indicate that single layer SC performed as well as C19 in late life.



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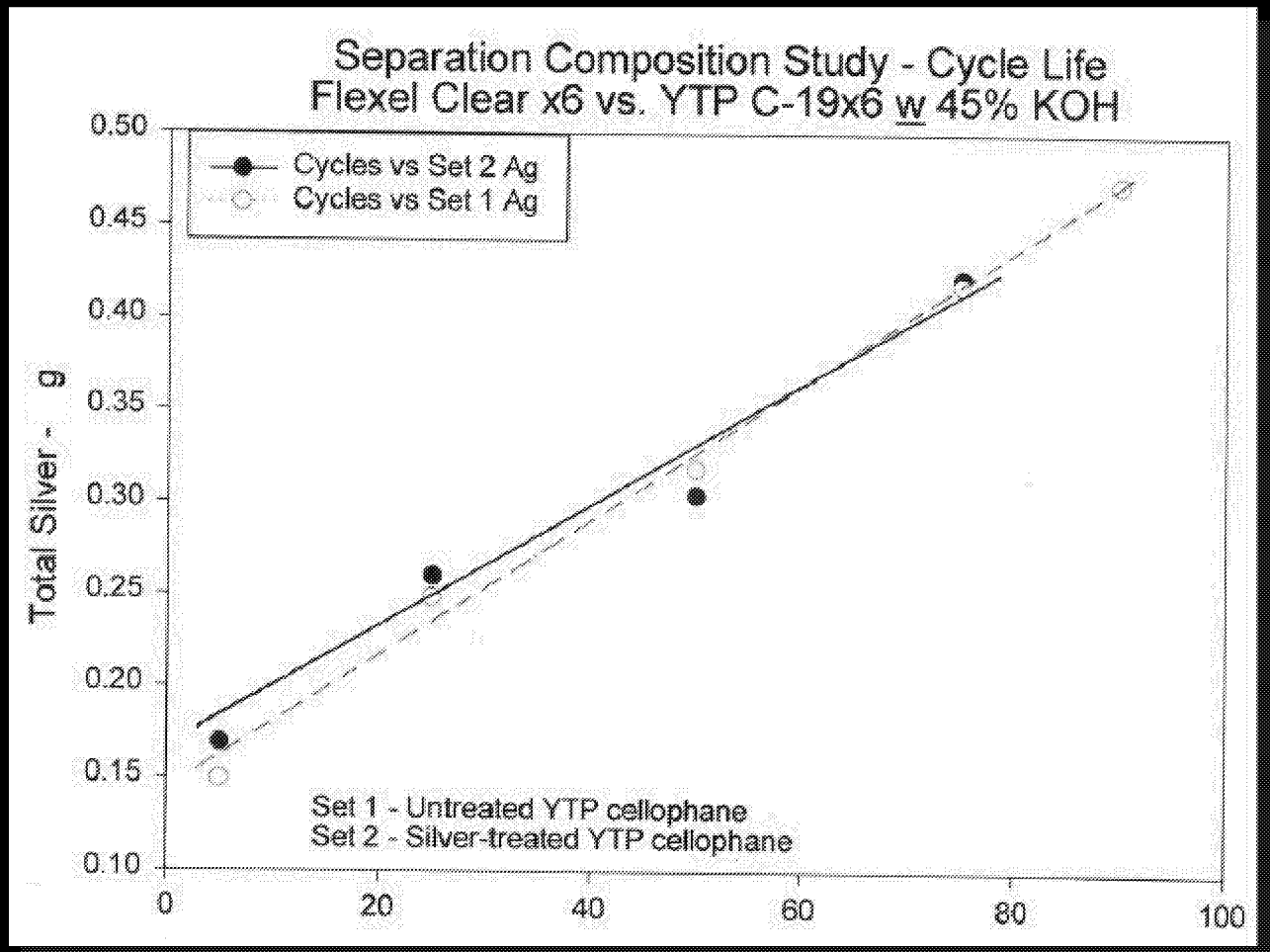
Silver migration in cycle life cells was identical for clear vs. silver-treated cellophane.



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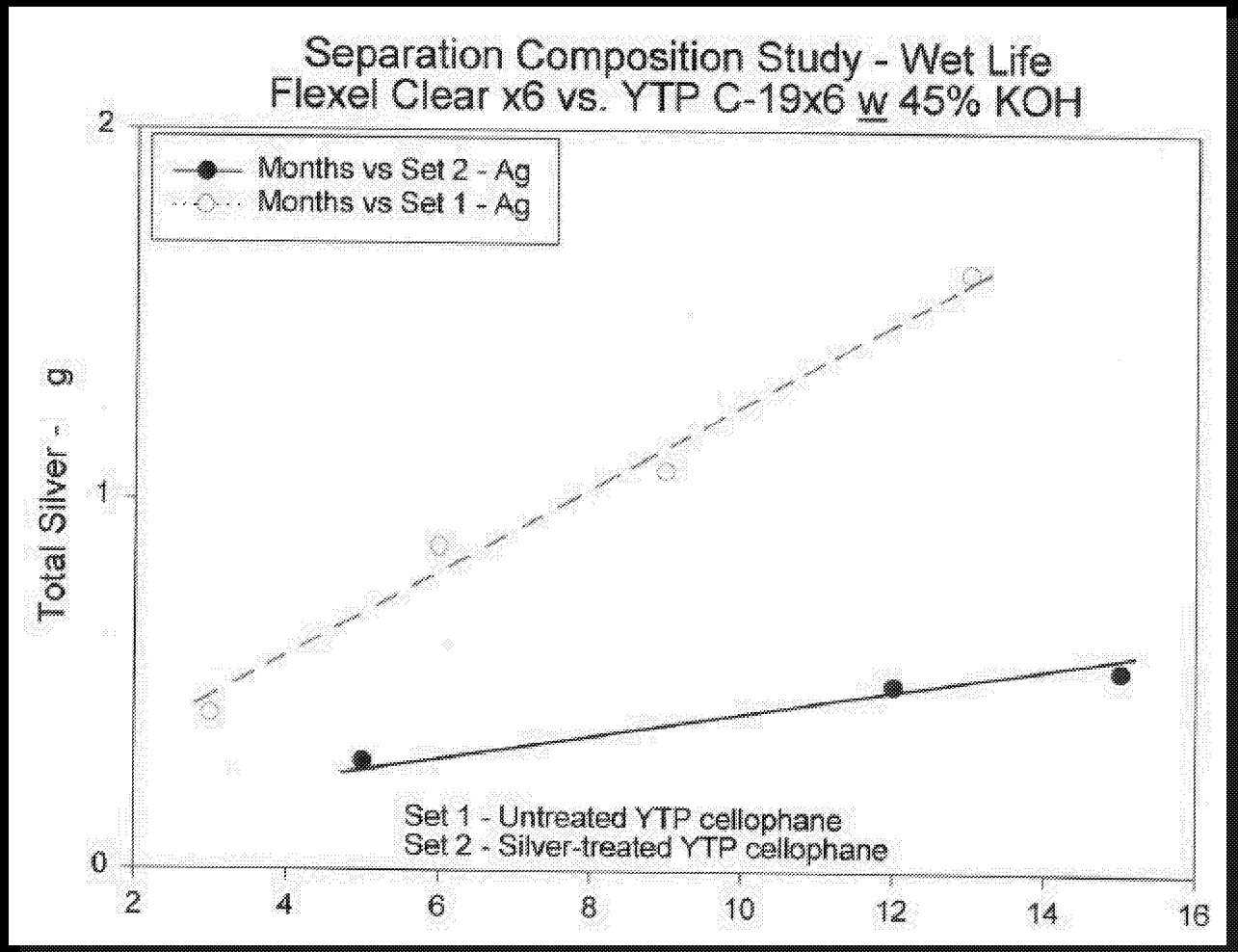
Silver migration in wet life cells occurred at a much lower rate for C19 cells.



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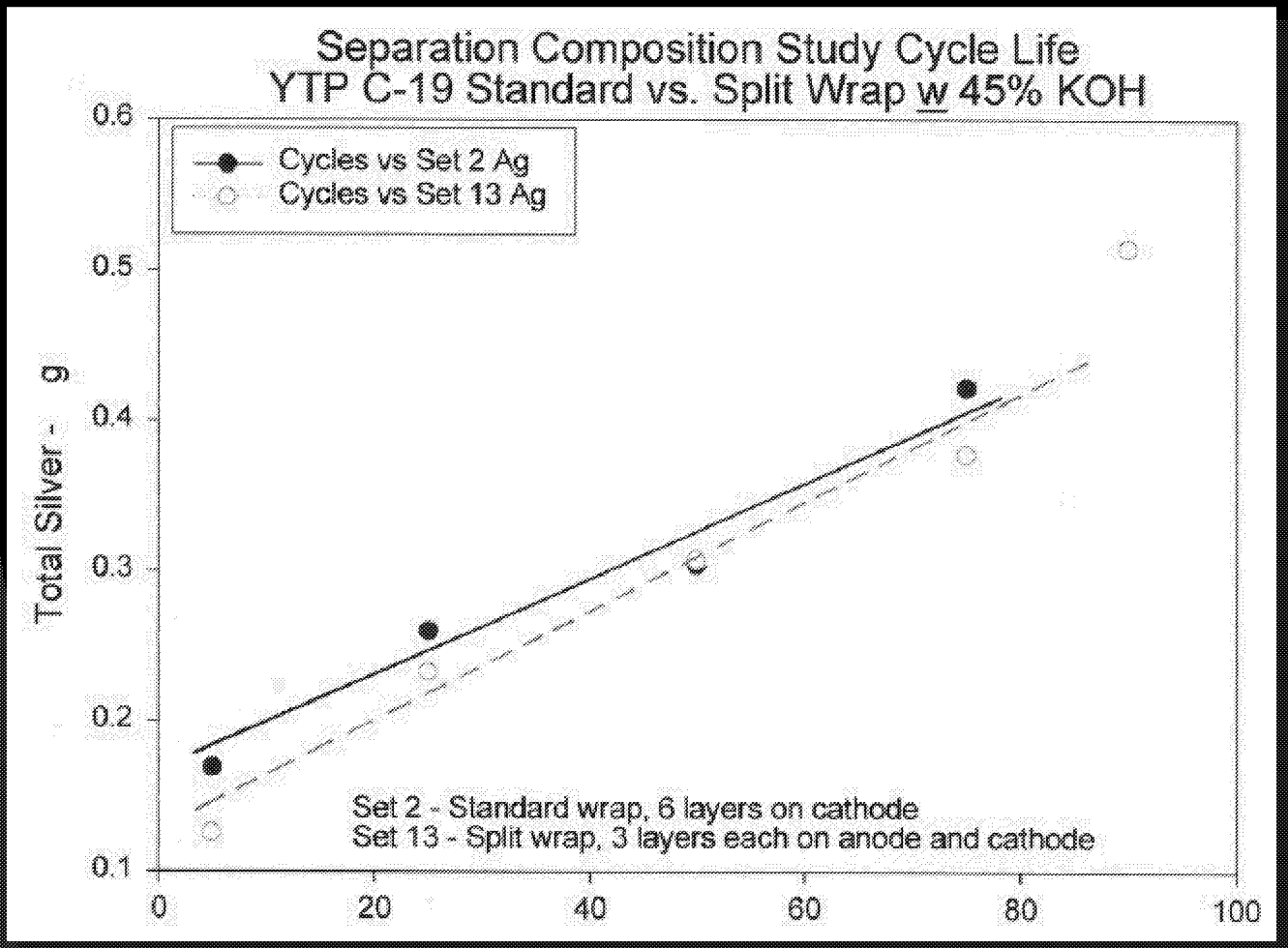
Silver migration for split wrap similar to standard wrap in cycle life.



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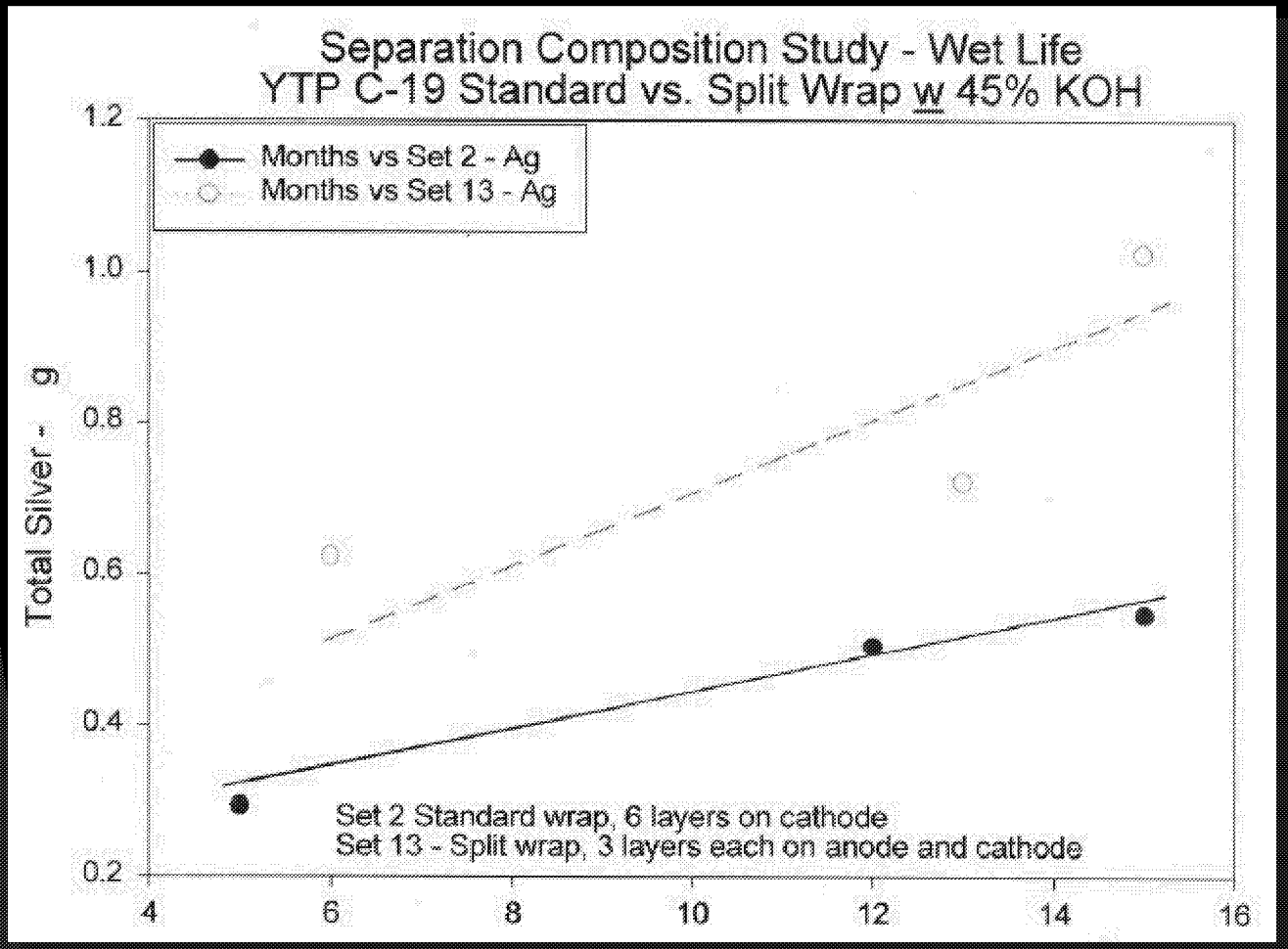
Silver migration in split wrap cells occurred at a much greater rate than for standard wrap cells in wet life.



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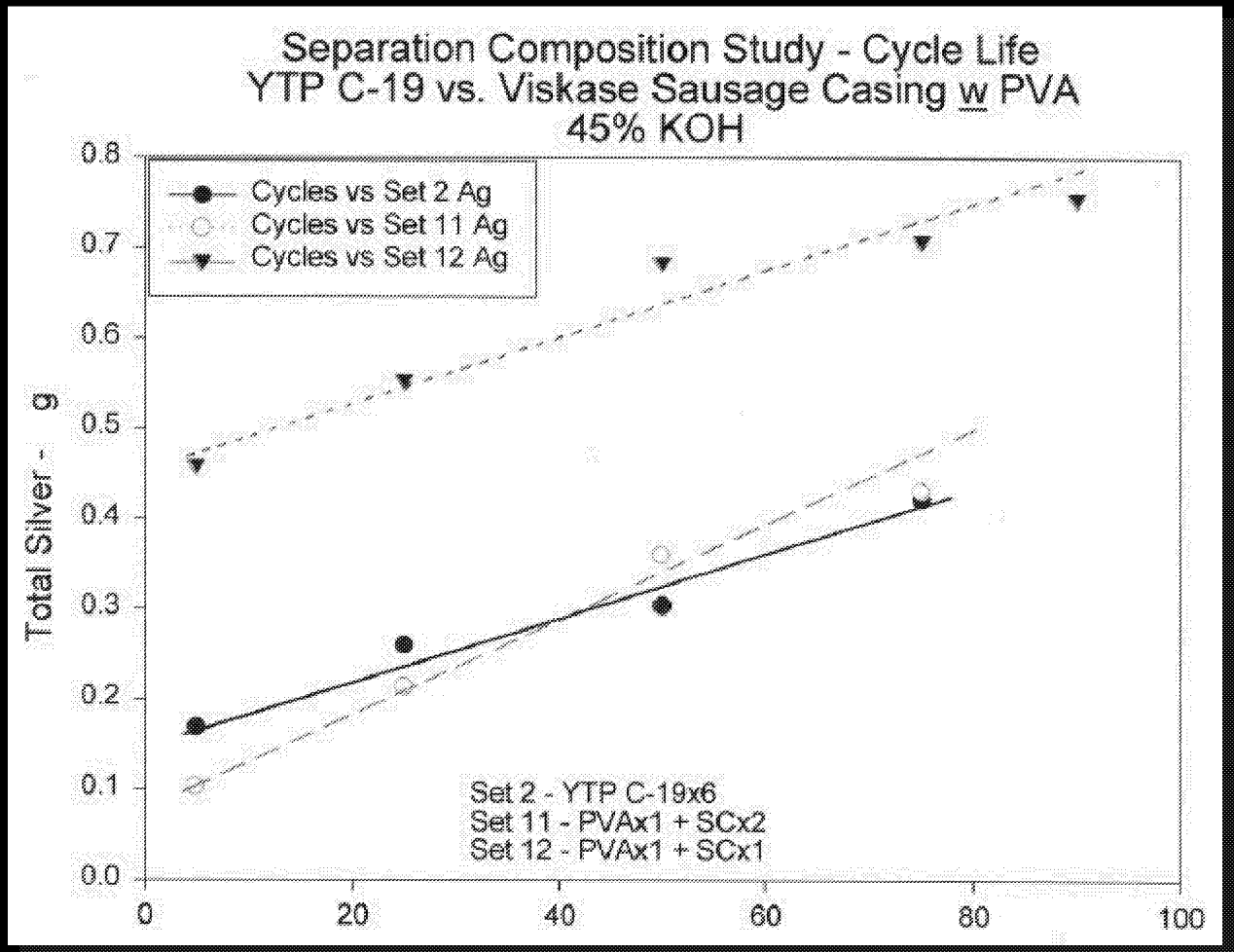
Although it appears that the single SC layer cells have a much higher silver migration rate than C19, layer-by-layer data show that all the silver in both SC sets was trapped at the PVA layer.



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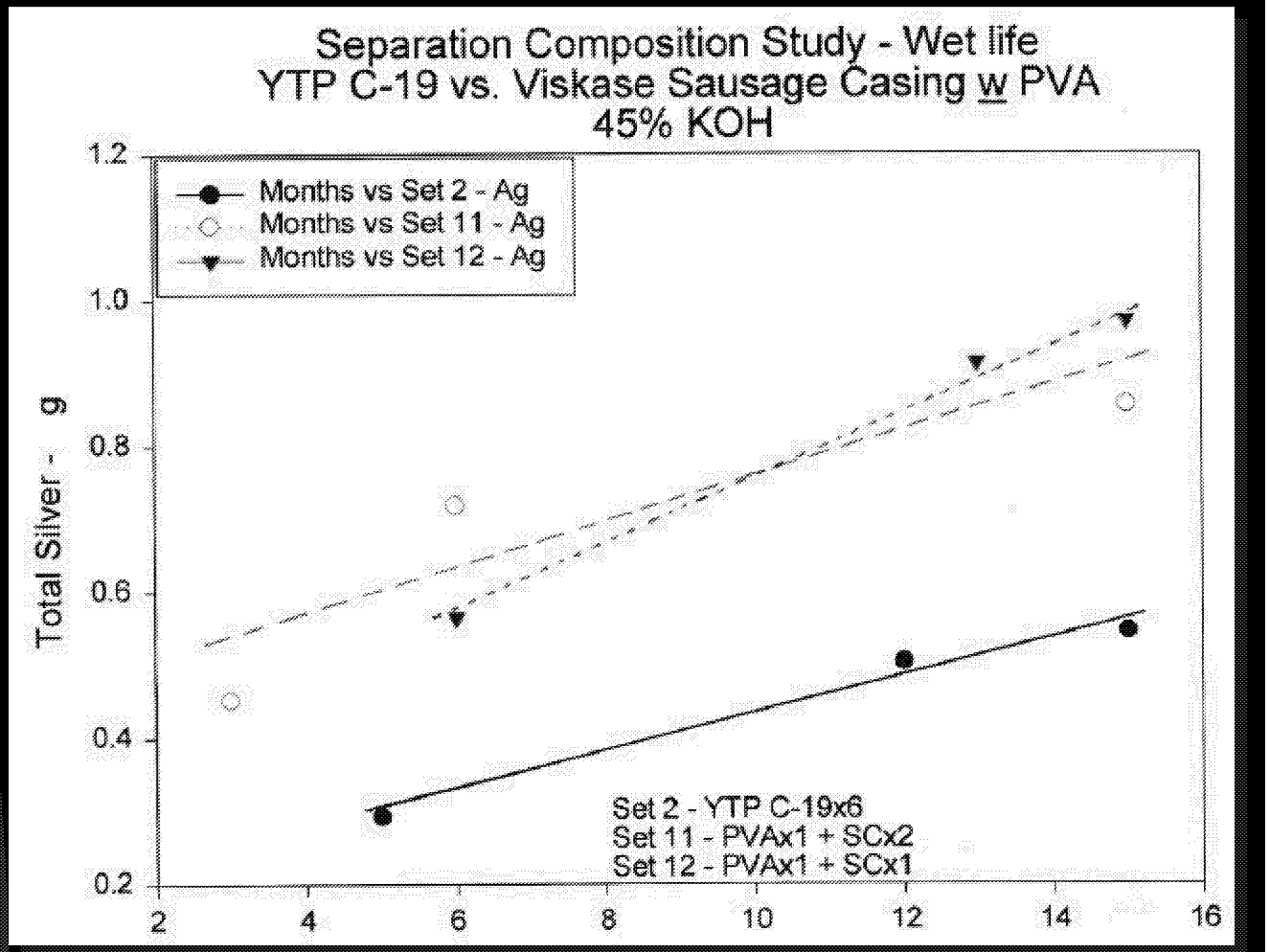
As in the cycle life data, here also the layer-by- layer data show that all the silver in the SC cells was stopped by the PVA film.



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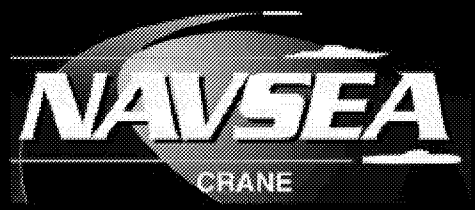

Conclusions

- Clear vs. Silver-Treated Cellophane
- Split wrap vs. “Standard” Wrap
- Cellophane vs. Sausage Casing

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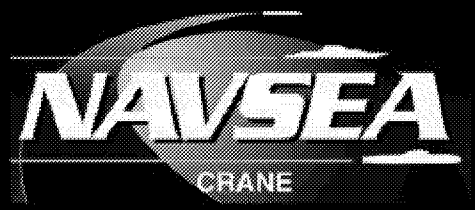

Recommendations

Use silver-treated cellophane instead of clear cellophane

Use split wrap for cellophane whenever possible

Strongly consider use of sausage casing with PVA film in the following configuration:

1-mil (tubular) SC/1-mil PVA film/2.3-mil plain or 6-mil fiber-reinforced SC tubular

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Acknowledgements

Cellophane film samples were purchased from Yardney Technical Products

Sausage Casing samples were furnished by Viskase Corporation

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