SPACESTATION LIVE

1
00:00:08,950 --> 00:00:07,590
so there's a lot of stuff happening on

2
00:00:11,110 --> 00:00:08,960
board the international space station a

3
00:00:13,110 --> 00:00:11,120
lot of different systems that work to

4
00:00:14,789 --> 00:00:13,120
support the crew members and one of

5
00:00:16,630 --> 00:00:14,799
those systems actually just celebrated a

6
00:00:18,310 --> 00:00:16,640
birthday this week i think it was seven

7
00:00:20,150 --> 00:00:18,320
years running now and it's the

8
00:00:21,670 --> 00:00:20,160
regenerative life support systems on

9
00:00:23,670 --> 00:00:21,680
board the international space station a

10
00:00:25,109 --> 00:00:23,680
very integral part of just keeping the

11
00:00:26,550 --> 00:00:25,119
crew members safe keeping them alive

12
00:00:29,589 --> 00:00:26,560
keeping them empowered to do their

13
00:00:32,549 --> 00:00:29,599

duties i'm joined now today by dave

14
00:00:34,950 --> 00:00:32,559
mathers currently one of the uh

15
00:00:37,510 --> 00:00:34,960
managers in the uh iss mission uh

16
00:00:39,990 --> 00:00:37,520
evaluation room the iss murr

17
00:00:41,430 --> 00:00:40,000
um and he used to be used to be an oso

18
00:00:43,430 --> 00:00:41,440
so you were an operations support

19
00:00:46,069 --> 00:00:43,440
officer correct yes it was all right

20
00:00:48,229 --> 00:00:46,079
well you know pretty important birthday

21
00:00:49,750 --> 00:00:48,239
for for the regenerative eclipse the the

22
00:00:51,189 --> 00:00:49,760
life support system that's pretty cool

23
00:00:53,110 --> 00:00:51,199
and now you were also used to work

24
00:00:54,389 --> 00:00:53,120
directly with that what was your role

25
00:00:57,430 --> 00:00:54,399
back when you were in oso to work with

26
00:00:59,510 --> 00:00:57,440
this stuff so the osos they are

27
00:01:00,950 --> 00:00:59,520
structures mechanisms and maintenance so

28
00:01:02,790 --> 00:01:00,960
not only the the nuts and bolts that

29
00:01:04,630 --> 00:01:02,800
hold the space station together but also

30
00:01:05,830 --> 00:01:04,640
fixing and repairing all the systems as

31
00:01:07,670 --> 00:01:05,840
they break down

32
00:01:11,270 --> 00:01:07,680
uh or or need to have the preventative

33
00:01:12,390 --> 00:01:11,280
maintenance as as need be um

34
00:01:13,910 --> 00:01:12,400
so when

35
00:01:15,830 --> 00:01:13,920
i came out of college i came into the

36
00:01:17,190 --> 00:01:15,840
oso group and was assigned to the

37
00:01:20,070 --> 00:01:17,200
eclipse system

38
00:01:21,590 --> 00:01:20,080

um and at that time regen eclipse was

39
00:01:24,070 --> 00:01:21,600
still on the ground still going through

40
00:01:27,429 --> 00:01:24,080
its final testing and things like that

41
00:01:29,270 --> 00:01:27,439
um and they were working to uh

42
00:01:31,429 --> 00:01:29,280
send it up early and to we're going to

43
00:01:32,469 --> 00:01:31,439
install in the lab before node 3 got

44
00:01:34,390 --> 00:01:32,479
there because node 3 was going to be

45
00:01:36,550 --> 00:01:34,400
much later

46
00:01:38,310 --> 00:01:36,560
so we had a lot of work to do to

47
00:01:39,990 --> 00:01:38,320
get the system up and get it installed

48
00:01:41,109 --> 00:01:40,000
in a place where it wasn't designed to

49
00:01:42,710 --> 00:01:41,119
have been installed in the first place

50
00:01:43,990 --> 00:01:42,720
we had to modify the lab

51
00:01:46,069 --> 00:01:44,000
uh install

52
00:01:47,510 --> 00:01:46,079
cables and hoses and

53
00:01:48,550 --> 00:01:47,520
new panels and things like that that

54
00:01:51,030 --> 00:01:48,560
didn't need to be that weren't there

55
00:01:53,670 --> 00:01:51,040
before and retrofit some

56
00:01:54,870 --> 00:01:53,680
fitted a vent that goes to space so that

57
00:01:56,630 --> 00:01:54,880
we could vent the

58
00:01:58,550 --> 00:01:56,640
hydrogen eventually uh when it comes

59
00:02:00,069 --> 00:01:58,560
from the oxygen generator

60
00:02:01,749 --> 00:02:00,079
um

61
00:02:03,910 --> 00:02:01,759
so that was a lot of work and the system

62
00:02:05,830 --> 00:02:03,920
was still on the ground and so we hadn't

63
00:02:07,429 --> 00:02:05,840

developed any of the procedures

64
00:02:09,830 --> 00:02:07,439
for uh for doing any of the maintenance

65
00:02:10,949 --> 00:02:09,840
once it got up onto space right uh on

66
00:02:12,710 --> 00:02:10,959
the station

67
00:02:14,790 --> 00:02:12,720
so uh

68
00:02:16,949 --> 00:02:14,800
being assigned to the ecosystem and

69
00:02:18,869 --> 00:02:16,959
being a new guy um

70
00:02:21,270 --> 00:02:18,879
i was a little more expendable than the

71
00:02:23,750 --> 00:02:21,280
than the folks that were on console so i

72
00:02:25,190 --> 00:02:23,760
got sent out to marshall a lot uh took a

73
00:02:27,670 --> 00:02:25,200
lot of trips out to marshall's place

74
00:02:29,350 --> 00:02:27,680
space flight center um to do fit checks

75
00:02:32,150 --> 00:02:29,360
on the systems as they as they were

76
00:02:33,910 --> 00:02:32,160
being installed um

77
00:02:34,790 --> 00:02:33,920
and the osos do that and allow for all

78
00:02:43,830 --> 00:02:34,800
the

79
00:02:46,309 --> 00:02:43,840
look like and um and also since those

80
00:02:48,229 --> 00:02:46,319
train the crew on maintenance they have

81
00:02:52,470 --> 00:02:48,239
an insight as to how the crew is going

82
00:02:53,830 --> 00:02:52,480
to see things so they can do those uh

83
00:02:55,030 --> 00:02:53,840
do those fit checks understand what the

84
00:02:55,830 --> 00:02:55,040
crew is going to see understand where

85
00:02:57,830 --> 00:02:55,840
we're going to need to put in the

86
00:02:59,830 --> 00:02:57,840
procedures and so on so i got to get

87
00:03:01,350 --> 00:02:59,840
very familiar with all of the

88
00:03:03,430 --> 00:03:01,360

regenerative

89
00:03:05,990 --> 00:03:03,440
life support systems

90
00:03:08,070 --> 00:03:06,000
and hardware because it was going and

91
00:03:10,229 --> 00:03:08,080
actually seeing all the hardware and

92
00:03:12,229 --> 00:03:10,239
putting tools and uh on the nuts and

93
00:03:14,149 --> 00:03:12,239
bolts and uh writing down notes and

94
00:03:15,030 --> 00:03:14,159
things like that okay well i mean since

95
00:03:16,790 --> 00:03:15,040
you're

96
00:03:17,750 --> 00:03:16,800
since you got to live it you got to

97
00:03:19,110 --> 00:03:17,760
breathe that it sounds like why don't

98
00:03:21,430 --> 00:03:19,120
you walk us through kind of the three

99
00:03:23,589 --> 00:03:21,440
major components of this regenerative

100
00:03:25,350 --> 00:03:23,599
life support system sure um

101
00:03:27,350 --> 00:03:25,360
and

102
00:03:28,309 --> 00:03:27,360
briefly there's uh actually kind of a

103
00:03:30,550 --> 00:03:28,319
fourth

104
00:03:31,270 --> 00:03:30,560
um you know cousin component as it were

105
00:03:32,949 --> 00:03:31,280
the

106
00:03:34,470 --> 00:03:32,959
waste and hygiene compartment

107
00:03:37,030 --> 00:03:34,480
it has to come come from there so when

108
00:03:39,750 --> 00:03:37,040
the when the crew members it all starts

109
00:03:41,110 --> 00:03:39,760
it all starts somewhere so the um they

110
00:03:43,910 --> 00:03:41,120
have to go to the bathroom like

111
00:03:47,750 --> 00:03:43,920
everybody else uh so when they

112
00:03:52,149 --> 00:03:49,670
that meets up with some pre-treat uh

113
00:03:54,470 --> 00:03:52,159

which keeps bugs from growing and keeps

114
00:03:56,710 --> 00:03:54,480
crystals from forming so that later when

115
00:03:58,309 --> 00:03:56,720
we concentrate it at all uh it doesn't

116
00:03:59,190 --> 00:03:58,319
clog up the system

117
00:04:00,710 --> 00:03:59,200
um

118
00:04:03,350 --> 00:04:00,720
it goes from there into the urine

119
00:04:06,630 --> 00:04:03,360
processor which is in wrs water recovery

120
00:04:09,270 --> 00:04:06,640
system rack number two uh it

121
00:04:10,949 --> 00:04:09,280
goes into the urine processor where

122
00:04:12,869 --> 00:04:10,959
there's some filters in there but mostly

123
00:04:14,710 --> 00:04:12,879
just for

124
00:04:16,390 --> 00:04:14,720
catching fuzz you know the lint and

125
00:04:18,069 --> 00:04:16,400
stuff that may have come out or or

126
00:04:20,629 --> 00:04:18,079
crystals or you know some solids that

127
00:04:21,990 --> 00:04:20,639
may form but mostly it's uh

128
00:04:23,030 --> 00:04:22,000
a distillery

129
00:04:23,830 --> 00:04:23,040
so it's

130
00:04:26,550 --> 00:04:23,840
it's

131
00:04:29,749 --> 00:04:26,560
old technology being applied uh in in a

132
00:04:31,189 --> 00:04:29,759
new in a new way okay um so the

133
00:04:32,629 --> 00:04:31,199
distillation assembly is the heart of

134
00:04:34,469 --> 00:04:32,639
the urine processor

135
00:04:36,550 --> 00:04:34,479
uh and it

136
00:04:37,830 --> 00:04:36,560
brings the pressure down so we bring it

137
00:04:39,510 --> 00:04:37,840
down to near vacuum inside the

138
00:04:41,110 --> 00:04:39,520

distillation assembly and it's just a

139
00:04:42,870 --> 00:04:41,120
spinning drum so that it keeps the

140
00:04:43,909 --> 00:04:42,880
fluids all on the outside

141
00:04:45,030 --> 00:04:43,919
um

142
00:04:46,230 --> 00:04:45,040
one of those

143
00:04:48,390 --> 00:04:46,240
low gravity

144
00:04:49,590 --> 00:04:48,400
adjustments we need to make uh it does

145
00:04:51,670 --> 00:04:49,600
that um

146
00:04:52,950 --> 00:04:51,680
and we heat it up a little bit evaporate

147
00:04:55,189 --> 00:04:52,960
the water out

148
00:04:56,950 --> 00:04:55,199
and then so whatever is not water gets

149
00:04:58,550 --> 00:04:56,960
left behind and that goes around a few

150
00:04:59,270 --> 00:04:58,560
times to make sure we get all the water

151
00:05:00,629 --> 00:04:59,280
out

152
00:05:02,230 --> 00:05:00,639
so you keep trickling in a little bit

153
00:05:04,469 --> 00:05:02,240
more from the

154
00:05:05,189 --> 00:05:04,479
from the waste hygiene compartment

155
00:05:08,950 --> 00:05:05,199
and

156
00:05:11,430 --> 00:05:08,960
then that water goes into the water

157
00:05:14,310 --> 00:05:11,440
processor okay where it meets up with

158
00:05:16,550 --> 00:05:14,320
condensate uh condensation that we pull

159
00:05:19,350 --> 00:05:16,560
from the air so our common cabin air

160
00:05:21,029 --> 00:05:19,360
assemblies the heat exchangers uh um the

161
00:05:22,469 --> 00:05:21,039
air conditioner basically token space

162
00:05:24,790 --> 00:05:22,479
station uh if you know your air

163
00:05:28,469 --> 00:05:24,800

conditioners at home they condense or in

164
00:05:30,230 --> 00:05:28,479
your car yeah they condense right um

165
00:05:31,430 --> 00:05:30,240
the moisture in the air condenses on the

166
00:05:33,350 --> 00:05:31,440
cooler surface

167
00:05:34,950 --> 00:05:33,360
so we draw that moisture out and this is

168
00:05:36,870 --> 00:05:34,960
the moisture that we breathe out you

169
00:05:38,710 --> 00:05:36,880
know when or that we sweat out from our

170
00:05:41,110 --> 00:05:38,720
normal this is just more stuff coming

171
00:05:42,710 --> 00:05:41,120
from the crew i mean they otherwise

172
00:05:45,110 --> 00:05:42,720
get rid of water they're putting more

173
00:05:46,230 --> 00:05:45,120
water back into the system yep

174
00:05:47,830 --> 00:05:46,240
and if we didn't take that out it would

175
00:05:49,350 --> 00:05:47,840
get pretty foggy and steamy instead of

176
00:05:50,710 --> 00:05:49,360
the iss

177
00:05:52,550 --> 00:05:50,720
so uh

178
00:05:54,950 --> 00:05:52,560
so it meets up with the distillate from

179
00:05:56,710 --> 00:05:54,960
the urine processor meets up with the

180
00:05:58,390 --> 00:05:56,720
condensation from the

181
00:05:59,749 --> 00:05:58,400
heat exchangers from the from the air

182
00:06:03,029 --> 00:05:59,759
conditioner

183
00:06:03,830 --> 00:06:03,039
that goes through a filtration system um

184
00:06:06,309 --> 00:06:03,840
and

185
00:06:07,749 --> 00:06:06,319
ion exchange resins

186
00:06:08,870 --> 00:06:07,759
where they

187
00:06:11,590 --> 00:06:08,880
filter out

188
00:06:13,670 --> 00:06:11,600

all the non-water stuff

189
00:06:15,110 --> 00:06:13,680
still can get through that is

190
00:06:15,990 --> 00:06:15,120
microbial things that may have been in

191
00:06:18,309 --> 00:06:16,000
there

192
00:06:20,710 --> 00:06:18,319
organic kind of materials

193
00:06:21,830 --> 00:06:20,720
so it goes into a catalytic reactor uh

194
00:06:23,990 --> 00:06:21,840
which

195
00:06:25,029 --> 00:06:24,000
has a catalyst in there and reacts with

196
00:06:26,230 --> 00:06:25,039
oxygen

197
00:06:27,670 --> 00:06:26,240
and that

198
00:06:29,749 --> 00:06:27,680
basically it uh

199
00:06:31,990 --> 00:06:29,759
breaks down the organic compounds that

200
00:06:33,430 --> 00:06:32,000
may still be in the water

201
00:06:35,510 --> 00:06:33,440
that goes through a gas separator pulls

202
00:06:37,270 --> 00:06:35,520
that those gas now gaseous compounds out

203
00:06:39,510 --> 00:06:37,280
because they've been broken down uh and

204
00:06:41,189 --> 00:06:39,520
then the now pure water comes out of

205
00:06:43,749 --> 00:06:41,199
that yep

206
00:06:46,790 --> 00:06:43,759
gets goes through and another ion

207
00:06:49,270 --> 00:06:46,800
resin where it adds iodine in

208
00:06:51,589 --> 00:06:49,280
so it's those ion exchange resins they

209
00:06:53,189 --> 00:06:51,599
exchange ions so it when there's not

210
00:06:55,270 --> 00:06:53,199
ions there it puts ones in it takes

211
00:06:57,189 --> 00:06:55,280
other ones out of three way so it adds

212
00:06:58,870 --> 00:06:57,199
iodine

213
00:06:59,670 --> 00:06:58,880

then goes into a storage system that

214
00:07:01,749 --> 00:06:59,680
that

215
00:07:04,390 --> 00:07:01,759
then goes out to the potable bus it's a

216
00:07:05,909 --> 00:07:04,400
potable water a drinkable water as has

217
00:07:07,909 --> 00:07:05,919
has iodine in it before the crew

218
00:07:10,710 --> 00:07:07,919
actually drinks it because some crew may

219
00:07:12,390 --> 00:07:10,720
be susceptible to iodine

220
00:07:15,430 --> 00:07:12,400
not all and it's a generally a safe

221
00:07:18,469 --> 00:07:16,950
boy scouts for example you bring a

222
00:07:20,469 --> 00:07:18,479
little iodine package to purify your

223
00:07:22,390 --> 00:07:20,479
water right um

224
00:07:25,510 --> 00:07:22,400
so the but we take the iodine out so

225
00:07:27,029 --> 00:07:25,520
that it doesn't build up in the crew uh

226
00:07:29,189 --> 00:07:27,039
at the potable water dispenser where

227
00:07:30,390 --> 00:07:29,199
they drink it or um or goes to the

228
00:07:31,749 --> 00:07:30,400
oxygen generator

229
00:07:33,670 --> 00:07:31,759
okay and that's our third part that's

230
00:07:36,790 --> 00:07:33,680
our third that's our third part yep uh

231
00:07:39,270 --> 00:07:36,800
so the oxygen generation assembly uh

232
00:07:40,710 --> 00:07:39,280
that is basically a um

233
00:07:42,230 --> 00:07:40,720
as an ion exchange so it takes the

234
00:07:45,189 --> 00:07:42,240
iodine back out so now it's just pure

235
00:07:46,790 --> 00:07:45,199
water again going into a cell stack um

236
00:07:50,950 --> 00:07:46,800
where you know water is hydrogen and

237
00:07:55,749 --> 00:07:54,070
separates the you electrolyze it and you

238
00:07:57,510 --> 00:07:55,759

separate you know separate the bonds

239
00:07:59,589 --> 00:07:57,520
between the oxygen hydrogen

240
00:08:02,070 --> 00:07:59,599
the hydrogen gets separated off and the

241
00:08:04,070 --> 00:08:02,080
oxygen goes out for the crew to breathe

242
00:08:07,270 --> 00:08:04,080
and then the hydrogen

243
00:08:08,790 --> 00:08:07,280
then goes and mixes with uh carbon

244
00:08:10,309 --> 00:08:08,800
dioxide that comes from our carbon

245
00:08:11,430 --> 00:08:10,319
dioxide removal assembly not part of

246
00:08:14,230 --> 00:08:11,440
regen but

247
00:08:17,270 --> 00:08:14,240
attached associated the carbon dioxide

248
00:08:18,710 --> 00:08:17,280
mixes in the sabote with does a chemical

249
00:08:20,150 --> 00:08:18,720
reaction there

250
00:08:21,350 --> 00:08:20,160
with the hydrogen

251
00:08:23,589 --> 00:08:21,360
and

252
00:08:24,869 --> 00:08:23,599
the output of that is water

253
00:08:26,710 --> 00:08:24,879
and methane

254
00:08:28,230 --> 00:08:26,720
then the methane we vent overboard and

255
00:08:29,909 --> 00:08:28,240
we don't have a use for that

256
00:08:33,110 --> 00:08:29,919
um and then the

257
00:08:35,190 --> 00:08:33,120
height the water now goes back into the

258
00:08:36,389 --> 00:08:35,200
um condensation bus and it basically

259
00:08:37,909 --> 00:08:36,399
goes right back to the beginning of the

260
00:08:39,269 --> 00:08:37,919
system and goes back into the end of the

261
00:08:41,509 --> 00:08:39,279
system so we just have this kind of

262
00:08:43,589 --> 00:08:41,519
constant loop going and feeding the loop

263
00:08:45,030 --> 00:08:43,599

and feeding and crew drinks of water it

264
00:08:47,269 --> 00:08:45,040
goes back into their system at the

265
00:08:49,110 --> 00:08:47,279
potable water dispenser um and they

266
00:08:52,070 --> 00:08:49,120
breathe the oxygen back in so that that

267
00:08:53,509 --> 00:08:52,080
comes back in comes back out as co2

268
00:08:55,030 --> 00:08:53,519
that goes around and around the water

269
00:08:56,389 --> 00:08:55,040
goes around and around all right

270
00:08:58,070 --> 00:08:56,399
yesterday's coffee becomes today's

271
00:08:58,790 --> 00:08:58,080
coffee yeah

272
00:09:01,269 --> 00:08:58,800
so

273
00:09:03,030 --> 00:09:01,279
i mean just listening to that there's

274
00:09:04,790 --> 00:09:03,040
a ton of stuff happening in these

275
00:09:06,630 --> 00:09:04,800
systems and it's been running for seven

276
00:09:08,710 --> 00:09:06,640
years now this isn't something that's

277
00:09:10,470 --> 00:09:08,720
been running you know non-stop without

278
00:09:12,470 --> 00:09:10,480
any issues it's almost like it's you

279
00:09:15,670 --> 00:09:12,480
know plumbing in any house apartment

280
00:09:17,110 --> 00:09:15,680
complex anything issues happen right but

281
00:09:18,630 --> 00:09:17,120
that's almost important for us because

282
00:09:20,310 --> 00:09:18,640
we needed to learn how to fix those

283
00:09:21,590 --> 00:09:20,320
issues right that's right

284
00:09:22,790 --> 00:09:21,600
um so

285
00:09:24,550 --> 00:09:22,800
a big

286
00:09:25,590 --> 00:09:24,560
part of and this is going to get to your

287
00:09:28,070 --> 00:09:25,600
later questions that already knows

288
00:09:30,949 --> 00:09:28,080

coming uh is developing the technology

289
00:09:32,790 --> 00:09:30,959
for future use right

290
00:09:35,590 --> 00:09:32,800
we hadn't had a regenerative system on

291
00:09:37,750 --> 00:09:35,600
space station before it's a one-off

292
00:09:38,870 --> 00:09:37,760
system so it's not like the your car

293
00:09:40,310 --> 00:09:38,880
that you have here on the ground or

294
00:09:41,350 --> 00:09:40,320
something like that where they've built

295
00:09:43,190 --> 00:09:41,360
thousands of them and they've been

296
00:09:44,070 --> 00:09:43,200
building thousands of them for many many

297
00:09:45,670 --> 00:09:44,080
years

298
00:09:47,269 --> 00:09:45,680
those still break down

299
00:09:49,269 --> 00:09:47,279
and we still have to fix them we just

300
00:09:52,310 --> 00:09:49,279
take that for road well

301
00:09:53,750 --> 00:09:52,320
on on board we got this large system

302
00:09:56,150 --> 00:09:53,760
that's the only one

303
00:09:57,590 --> 00:09:56,160
and we're using it as it goes and we're

304
00:09:59,030 --> 00:09:57,600
learning about it as it goes some of the

305
00:10:01,190 --> 00:09:59,040
things that we didn't know were going to

306
00:10:02,550 --> 00:10:01,200
happen or that we didn't fully

307
00:10:04,069 --> 00:10:02,560
understand about some tweaks and things

308
00:10:05,430 --> 00:10:04,079
like that for it operates a little

309
00:10:07,910 --> 00:10:05,440
differently on orbit than it did here on

310
00:10:09,350 --> 00:10:07,920
the ground and that kind of stuff um

311
00:10:10,310 --> 00:10:09,360
one of the the major things that we

312
00:10:11,670 --> 00:10:10,320
needed to

313
00:10:13,750 --> 00:10:11,680

overcome early

314
00:10:14,630 --> 00:10:13,760
was um

315
00:10:16,470 --> 00:10:14,640
the uh

316
00:10:17,750 --> 00:10:16,480
the crew members there and this goes

317
00:10:19,590 --> 00:10:17,760
into the science and part of the reason

318
00:10:21,509 --> 00:10:19,600
we were talking earlier about we have a

319
00:10:23,670 --> 00:10:21,519
crew member on board for one year

320
00:10:25,350 --> 00:10:23,680
uh one of the things that they try to

321
00:10:27,590 --> 00:10:25,360
learn is what it does to your body now

322
00:10:29,350 --> 00:10:27,600
one of the things that happens is uh

323
00:10:31,190 --> 00:10:29,360
because you're not putting stresses on

324
00:10:33,350 --> 00:10:31,200
your bones

325
00:10:35,350 --> 00:10:33,360
your body isn't constantly replenishing

326
00:10:36,310 --> 00:10:35,360
or replacing the the minor little stress

327
00:10:38,949 --> 00:10:36,320
fractures in your bones and is

328
00:10:40,069 --> 00:10:38,959
constantly regenerating your bone

329
00:10:42,389 --> 00:10:40,079
on orbit you don't have all those

330
00:10:43,590 --> 00:10:42,399
stresses so kind of like muscles can

331
00:10:45,030 --> 00:10:43,600
atrophy if you're not using them you

332
00:10:47,509 --> 00:10:45,040
know you're not using your bones they

333
00:10:49,829 --> 00:10:47,519
can atrophy too uh so

334
00:10:51,190 --> 00:10:49,839
the calcium leeches out of your bones

335
00:10:53,110 --> 00:10:51,200
well when they were doing all the

336
00:10:54,630 --> 00:10:53,120
testing here on the ground it was with

337
00:10:56,230 --> 00:10:54,640
people who walk around in gravity all

338
00:10:58,790 --> 00:10:56,240

that problem right didn't have that

339
00:11:00,310 --> 00:10:58,800
problem and we didn't fully understand

340
00:11:02,710 --> 00:11:00,320
how much calcium was really coming out

341
00:11:05,670 --> 00:11:02,720
of the group

342
00:11:07,590 --> 00:11:05,680
we found out very early on with

343
00:11:09,670 --> 00:11:07,600
the distillation assembly where it

344
00:11:12,389 --> 00:11:09,680
concentrates the urine right the

345
00:11:15,509 --> 00:11:12,399
pre-treated urine

346
00:11:17,670 --> 00:11:15,519
the pre-treat is uh

347
00:11:18,630 --> 00:11:17,680
amongst other chemicals uh sulfuric acid

348
00:11:21,269 --> 00:11:18,640
in it

349
00:11:23,670 --> 00:11:21,279
uh and it's it's very acidic or ph

350
00:11:26,550 --> 00:11:23,680
right it's very acidic stuff um

351
00:11:28,230 --> 00:11:26,560
well the sulfuric acid the sulfur ions

352
00:11:29,990 --> 00:11:28,240
in the sulfuric acid we're reacting with

353
00:11:31,030 --> 00:11:30,000
the calcium ions from the crew and

354
00:11:34,949 --> 00:11:31,040
making

355
00:11:37,990 --> 00:11:34,959
um basically gypsum calcium sulfide uh

356
00:11:39,509 --> 00:11:38,000
which is not soluble and uh it it

357
00:11:42,150 --> 00:11:39,519
clogged up the system clogged up the

358
00:11:43,829 --> 00:11:42,160
distillation assembly and uh um gypsum

359
00:11:46,310 --> 00:11:43,839
is uh

360
00:11:48,150 --> 00:11:46,320
drywall okay that's the stuff inside so

361
00:11:50,629 --> 00:11:48,160
imagine crumbling a bunch of that up and

362
00:11:53,030 --> 00:11:50,639
putting into inside of a complex complex

363
00:11:54,310 --> 00:11:53,040

complex machinery um

364
00:11:57,829 --> 00:11:54,320
so that's something that we learned and

365
00:11:59,110 --> 00:11:57,839
uh we reduced our concentration level uh

366
00:12:00,710 --> 00:11:59,120
from that you know

367
00:12:04,310 --> 00:12:00,720
we stopped

368
00:12:05,430 --> 00:12:04,320
taken out so it was still soluble at

369
00:12:07,350 --> 00:12:05,440
that point

370
00:12:09,190 --> 00:12:07,360
and then inside what we're working on

371
00:12:10,870 --> 00:12:09,200
right now will be actually

372
00:12:12,790 --> 00:12:10,880
should be instituting this uh this

373
00:12:15,030 --> 00:12:12,800
coming increment is an alternate

374
00:12:16,870 --> 00:12:15,040
pre-treat so we okay learn from this and

375
00:12:18,710 --> 00:12:16,880
we are changing our pre-treat to a

376
00:12:20,790 --> 00:12:18,720
different chemical i think it's phosphor

377
00:12:23,110 --> 00:12:20,800
space but um

378
00:12:24,629 --> 00:12:23,120
yeah and then it but it stays in

379
00:12:26,550 --> 00:12:24,639
solution when it reacts with the calcium

380
00:12:28,069 --> 00:12:26,560
so i mean we we have this complex system

381
00:12:29,670 --> 00:12:28,079
it's been running for seven years now

382
00:12:31,670 --> 00:12:29,680
and before you know before we go i want

383
00:12:33,750 --> 00:12:31,680
to get into you know why is something

384
00:12:35,590 --> 00:12:33,760
like this going to be important

385
00:12:37,829 --> 00:12:35,600
for you know a future mission to mars

386
00:12:40,629 --> 00:12:37,839
why is something like this so vital and

387
00:12:42,230 --> 00:12:40,639
also you know not just mars has this

388
00:12:44,550 --> 00:12:42,240

been i mean this is a very complex

389
00:12:45,829 --> 00:12:44,560
technology and you said you mentioned a

390
00:12:47,509 --> 00:12:45,839
lot of things down here on the ground

391
00:12:50,550 --> 00:12:47,519
that it's similar to have there been any

392
00:12:52,389 --> 00:12:50,560
kind of feedbacks any benefits received

393
00:12:54,230 --> 00:12:52,399
down here on earth from the work we've

394
00:12:56,230 --> 00:12:54,240
been doing up in space

395
00:12:58,310 --> 00:12:56,240
um yeah a little bit uh

396
00:13:00,470 --> 00:12:58,320
for the most part um

397
00:13:02,389 --> 00:13:00,480
they're it's standard technologies or

398
00:13:04,710 --> 00:13:02,399
old technology distilling for example

399
00:13:07,110 --> 00:13:04,720
that's that's been going on for

400
00:13:09,430 --> 00:13:07,120
eons yeah right um

401
00:13:11,829 --> 00:13:09,440
and a lot of moonshine stills out in the

402
00:13:13,750 --> 00:13:11,839
backwoods of uh of the smoky mountains

403
00:13:16,949 --> 00:13:13,760
um this one's just water though this

404
00:13:19,829 --> 00:13:16,959
one's just water uh

405
00:13:22,550 --> 00:13:19,839
so that's that's a uh it's not a new

406
00:13:24,870 --> 00:13:22,560
technological development it is it was a

407
00:13:27,829 --> 00:13:24,880
difficult challenge getting that to work

408
00:13:29,590 --> 00:13:27,839
in zero gravity so applying zero gravity

409
00:13:31,829 --> 00:13:29,600
kind of solutions and developments like

410
00:13:33,110 --> 00:13:31,839
that to the ground is

411
00:13:34,550 --> 00:13:33,120
it doesn't translate as well the other

412
00:13:37,350 --> 00:13:34,560
directions sometimes

413
00:13:41,910 --> 00:13:37,360

um but what about so true to mars why is

414
00:13:43,670 --> 00:13:41,920
this going to be so vital um well

415
00:13:45,750 --> 00:13:43,680
to finish your other other question real

416
00:13:47,189 --> 00:13:45,760
quick i'm sorry uh is that one of the

417
00:13:49,670 --> 00:13:47,199
things that we have used though is that

418
00:13:52,230 --> 00:13:49,680
microbial check valve it's one of those

419
00:13:54,470 --> 00:13:52,240
ions that uh ion exchange resins

420
00:13:56,470 --> 00:13:54,480
and it lets the

421
00:13:59,269 --> 00:13:56,480
water go through but it because it's a

422
00:14:01,110 --> 00:13:59,279
microbial uh barrier keeps microbes from

423
00:14:03,350 --> 00:14:01,120
going through that's actually being used

424
00:14:05,590 --> 00:14:03,360
in third world countries disaster uh

425
00:14:08,470 --> 00:14:05,600
relief efforts that kind of thing

426
00:14:10,389 --> 00:14:08,480
there's a non-profit company called

427
00:14:12,870 --> 00:14:10,399
care for kids or a concern for kids

428
00:14:14,389 --> 00:14:12,880
excuse me um that does that so they they

429
00:14:15,269 --> 00:14:14,399
are using some of our technology here on

430
00:14:16,870 --> 00:14:15,279
the ground

431
00:14:18,150 --> 00:14:16,880
but most of it the

432
00:14:19,670 --> 00:14:18,160
oxygen generator that's used in

433
00:14:21,990 --> 00:14:19,680
submarines

434
00:14:23,189 --> 00:14:22,000
um important for going to mars uh and

435
00:14:25,030 --> 00:14:23,199
part of why it was important for us to

436
00:14:27,030 --> 00:14:25,040
install here is that uh

437
00:14:28,150 --> 00:14:27,040
we go through a lot of water as people

438
00:14:30,069 --> 00:14:28,160

we don't you don't realize that you're

439
00:14:31,829 --> 00:14:30,079
thirsty you just get a drink and but we

440
00:14:33,670 --> 00:14:31,839
can go through up to a liter of water a

441
00:14:35,509 --> 00:14:33,680
day yeah and so

442
00:14:36,710 --> 00:14:35,519
um not always some people are different

443
00:14:38,310 --> 00:14:36,720
but it would go through an awful lot of

444
00:14:39,110 --> 00:14:38,320
water water's heavy

445
00:14:41,829 --> 00:14:39,120
um

446
00:14:43,030 --> 00:14:41,839
and getting things to space you pay by

447
00:14:46,550 --> 00:14:43,040
the pound

448
00:14:48,310 --> 00:14:46,560
uh so um

449
00:14:49,910 --> 00:14:48,320
it's expensive to pay for things by the

450
00:14:51,189 --> 00:14:49,920
pound and it's expensive to get all that

451
00:14:52,550 --> 00:14:51,199
water up there when you're supporting a

452
00:14:54,069 --> 00:14:52,560
lot of crew

453
00:14:55,509 --> 00:14:54,079
that's uh

454
00:14:57,110 --> 00:14:55,519
and that's mass that you could be using

455
00:14:59,350 --> 00:14:57,120
for bringing up

456
00:15:02,150 --> 00:14:59,360
hardware yep more science more science

457
00:15:03,110 --> 00:15:02,160
more anything else

458
00:15:05,430 --> 00:15:03,120
so

459
00:15:07,590 --> 00:15:05,440
conserving as much water as possible is

460
00:15:09,590 --> 00:15:07,600
very important um

461
00:15:12,949 --> 00:15:09,600
so when we conserve most of it right now

462
00:15:14,629 --> 00:15:12,959
we're recovering about 75 percent of the

463
00:15:15,670 --> 00:15:14,639

of the water from the from the urine the

464
00:15:17,509 --> 00:15:15,680
condensate

465
00:15:18,629 --> 00:15:17,519
uh

466
00:15:20,069 --> 00:15:18,639
hopefully in the future with this new

467
00:15:22,710 --> 00:15:20,079
preachy we can go much higher than that

468
00:15:24,150 --> 00:15:22,720
so going to mars you won't be able to

469
00:15:26,389 --> 00:15:24,160
send them water all the time you won't

470
00:15:27,509 --> 00:15:26,399
be able to no reason fly flights

471
00:15:29,350 --> 00:15:27,519
right

472
00:15:31,030 --> 00:15:29,360
or very few and so you don't want to use

473
00:15:33,030 --> 00:15:31,040
all that space for water when you could

474
00:15:34,069 --> 00:15:33,040
recover it so that's uh that's why

475
00:15:36,310 --> 00:15:34,079
that's

476
00:15:38,310 --> 00:15:36,320
very important well again space station

477
00:15:39,749 --> 00:15:38,320
regenerative eclipse the the life

478
00:15:41,509 --> 00:15:39,759
support the water

479
00:15:43,269 --> 00:15:41,519
recycling everything turning seven this

480
00:15:45,110 --> 00:15:43,279
week very exciting i mean seven years

481
00:15:46,629 --> 00:15:45,120
down and i'm sure it's going to be a lot

482
00:15:47,990 --> 00:15:46,639
of advancements in the future as we

483
00:15:49,749 --> 00:15:48,000
continue to get ready for the journey

484
00:15:52,389 --> 00:15:49,759
tomorrow a lot more work to be done

485
00:15:54,790 --> 00:15:52,399
again dave mathers one of our iss mer

486
00:15:56,710 --> 00:15:54,800
managers here for mission control thanks

487
00:15:58,470 --> 00:15:56,720
so much for joining me today giving us a

488
00:15:59,670 --> 00:15:58,480

a real in-depth look at everything

489
00:16:01,509 --> 00:15:59,680
that's going on on that i really