good afternoon and welcome to NASA's Kennedy Space Center and the forward osmosis bag experiment demonstration joining us today are dr. howard levine nasa project scientist and monica solaire project engineer with kinetic north america will begin with some opening statements and then go into the demonstration so we'd like to show to you a tech demo project that's flying on the shuttle Atlantis this Friday all right it's what we call the forward osmosis back so think of it as a bag with in a bag and the outer bag you can
introduce dirty water or water that cannot be drunk by the astronauts on the interior the inner clean bag we introduce a high sugar solution concentrate and just by osmosis it cleans the water it pulls the water through a semipermeable membrane selectively excludes elements compounds bacterial viral particles that are not desirable and you end up with a sports drink that maybe four to six hours later can be drunk by the crew members this technology was developed at Ames Research Center and it was licensed to
accompany hydration corporation in in Oregon and they went through the SBIR a small business innovative research program to commercialize it and they developed this product which is for hikers so that hikers out in the wild can put this into a stream and water that may not be suitable for parasites or suitable for parasites but not for drinking can be cleaned in this way there's also a version of this that has been modified for the Department of Defense for soldiers in the field the Coast Guard has also developed a version
for salt water to make salt water

44
00:02:13,530 --> 00:02:22,949
a couple so the project will be flying

45
00:02:19,800 --> 00:02:25,439
on Friday we're going to be first we had

46
00:02:22,949 --> 00:02:29,009
to modify the bag so this commercial

47
00:02:25,439 --> 00:02:32,099
product is not flight rated as we say

48
00:02:29,009 --> 00:02:34,530
it's a as materials that are don't meet

49
00:02:32,099 --> 00:02:37,169
the stringent flight requirements of the

50
00:02:34,530 --> 00:02:39,989
International Space Station so we

51
00:02:37,169 --> 00:02:43,679
created a flight version that has the

52
00:02:39,989 --> 00:02:45,599
proper materials and Monica's going to

53
00:02:43,680 --> 00:02:48,360
go through a demonstration of how the

54
00:02:45,599 --> 00:02:51,959
crew members will load it up both the

55
00:02:48,360 --> 00:02:54,420
dirty side and the clean side and in the

56
00:02:51,959 --> 00:02:57,000
experiment we're going to be flying six

57
00:02:54,419 --> 00:03:01,289
of these bags three of which will be
00:02:57,000 --> 00:03:330
manually mixed by the crew and three of

00:03:01,289 --> 00:03:05,189
which will not be so we'll be seeing

00:03:03,330 --> 00:03:09,719
whether there's a requirement for them

00:03:05,189 --> 00:03:11,068
to be manually mixed or not okay so what

00:03:09,719 --> 00:03:12,840
we have here what will be flying on

00:03:11,068 --> 00:03:15,199
Friday we're actually gonna be flying

00:03:12,840 --> 00:03:18,269
seven of these forward osmosis kits

00:03:15,199 --> 00:03:20,369
they're made out of Nomex and inside of

00:03:18,269 --> 00:03:23,310
the kit it's going to hold a forward

00:03:20,370 --> 00:03:26,069
osmosis bag an osmotic concentrate

00:03:23,310 --> 00:03:28,949
syringe forward osmosis sampling syringe

00:03:26,069 --> 00:03:31,319
and the input storage bag and each kits

00:03:28,949 --> 00:03:34,018
going to have a letter identifier a b c

00:03:31,319 --> 00:03:37,109
d and so on for the crew member to
associate with so as howard was saying

we modified the commercially available

off-the-shelf product and change the

materials from PVC to polyethylene for

flammability purposes and we also change

the ports to self sealing quick

disconnect ports for leakage purposes

you can imagine trying to pour in some

water into one of these big red ports

and microgravity you'll have water

flying everywhere we also have your

standard 60 milliliter syringe which is

going to hold fructose and glucose

syrups and deionized water as howard had
mentioned it's going to be injected into

the inner chamber of the forward osmosis

bag the sampling syringe is an identical

version of the osmotic concentrate

syringe which will be pulling the 60

milliliters sample approximately six

hours after each bag is induced and the

input storage bag

olds fit 500 milliliters of potassium

chloride and a methyl blue dye which is

your typical food coloring over the

counter died and both of these items

will be launched pre-loaded and all of

the lab work is being done at the space
life science lab here at Kennedy Space Center so to begin the initiation the crew member is going to transfer all of the liquid from the input storage bag into the outer chamber of the forward osmosis bag using this forward osmosis pumps orange so rotate this to make it a little easier so the crew member will ensure that the check valve that we have here is in the off position towards the forward osmosis bag the velcro that we have on the input storage bag is used to assist the crew member in pushing all the liquid towards the outlet of the input storage bag so they can roll the
bag just like that and they're able to
get all the liquid towards the outlet
and they'll be pulling liquid into the
forward osmosis pump syringe just like
this and then once they have it
approximately full they're going to move
the check valve in the off direction of
the input storage bag and slowly inject
the forward osmosis bag with the dirty
water now this cycle should take up to
about eight times eight cycles for the
crew member to get as much water as they
can out of the input storage bag so I'll
go through this quickly
so as the water lessons i'll keep rolling the bag using the velcro to pull the dirty solution

now the purpose of the methyl blue dye is too wet the membrane it's to dye the membrane so when the forward osmosis bags are returned for a post flight analysis we're going to be able to dissect the forward osmosis bag and see how the liquid wetted the membrane whether or not it was a uniform wedding or if it was splotchy do a couple more pools and then once they've gotten as much liquid out of the input storage bag
as they possibly can they'll use a dry wipe which they already have up there just to make sure there's no spots that come out to disconnect the cuties from the input storage bag and the forward osmosis bag so as you can see all the liquid is on the outer chamber of the forward osmosis bag then we're going to they're going to come and grab the osmotic concentrate syringe and inject the osmotic concentrate to the inner chamber of the forward osmosis bag and the osmotic concentrate is the driver for the water to pass through the
membrane so the higher concentrated

00:08:23,240 --> 00:08:28,038
liquid pulls the potable water through

00:08:25,759 --> 00:08:31,309
the membrane so once they're done with

00:08:28,038 --> 00:08:34,218
that they'll disconnect and as Howard

00:08:31,309 --> 00:08:37,099
said three of the six bags are going to

00:08:34,219 --> 00:08:40,579
be hand manipulated so handshaking for

00:08:37,099 --> 00:08:43,000
approximately two hours and this is just

00:08:40,578 --> 00:08:45,078
to compare whether or not mechanical

00:08:43,000 --> 00:08:47,328
mechanically inducing the bags will

00:08:45,078 --> 00:08:50,289
actually crease the flux way to the

00:08:47,328 --> 00:08:52,458
water moving through the membrane or if

00:08:50,289 --> 00:08:55,639
two minutes approximately two minutes

00:08:52,458 --> 00:08:58,099
yeah so once they're complete with the

00:08:55,639 --> 00:08:59,810
initiation and the mixing of the bags

00:08:58,100 --> 00:09:03,110
and they're going to resew them back
into this forward osmosis kits and back

into the storage medical

Walker and approximately six hours after

this is done they're going to come back

and they're going to remove a 60

milliliters sample from the inner

chamber of the bag using this forward

osmosis sampling syringe very similar to

the way we did with the osmotic

concentrate syringe they're just going

to connect it and remove the 60

milliliters sample I won't remove a

sample right now just because there's

only been a couple minutes since I've
actually initiated the bag so you probably won't see much of anything and then they're going to restore everything back into the forward osmosis kit and back into the locker for a return all operations are going to occur within two days of landing and all the post-fight analysis will be done here at the space life science lab at Kennedy Space Center and so the key part of the science is six hours later when the crew member goes and withdraws the 60 millimeter sample you saw that this osmotic concentrate is yellow okay it has a dye
in it a fluorescein dye the sample that we collect will be diluted based on the water that's passed through the membrane.

all right so this is our microgravity sample this is the most important sample of the whole experiment and we'll be able to run this through a spectrophotometer post-flight and get an idea of the flux rate of the water passage through the semipermeable membrane based on the dilution of this dye this other blue dye as Monica said is to get an idea of the the distribution of the water in
microgravity on the semipermeable

00:10:51,200 --> 00:10:57,110
membrane okay and now we'll take

00:10:55,220 --> 00:11:00,519
questions please state your name and

00:10:57,110 --> 00:11:00,519
affiliation and wait for the microphone

00:11:02,700 --> 00:11:07,720
Jim Siegel celebration independent

00:11:05,289 --> 00:11:10,500
newspaper so so let me get this straight

00:11:07,720 --> 00:11:13,870
nobody's going to drink anything of

00:11:10,500 --> 00:11:16,990
that's been sampled here or experimented

00:11:13,870 --> 00:11:21,179
with on this on this flight correct

00:11:16,990 --> 00:11:23,529
that's correct and that so could you

00:11:21,179 --> 00:11:26,469
describe a little bit about what this

00:11:23,529 --> 00:11:28,149
would replace if it was to be used on

00:11:26,470 --> 00:11:32,110
the space shuttle or the International

00:11:28,149 --> 00:11:35,350
Space Station in in a little bit of

00:11:32,110 --> 00:11:37,720
detail and how large would something
like that have to be on the space shuttle or the space station in order to do that so we think of this primarily as an emergency contingency water system so in the event that one of the normal physical chemical means of producing potable water went down this could be used in an emergency situation it could also be used in the future as part of an EV a extra vehicle activity suit some of you may be science fiction fans you may have read the dune series with the Fremen on Arrakis and they had still suits well this could be you know almost
a first step towards recapturing the humidity from our sweat from our breath even from our urine and recycling it and making it drinkable so mostly I guess to answer your question as an emergency situation it's not meant to be a day-to-day water generation device but it could also be used when the crew comes back on on a capsule and they land in the ocean it could be filled with seawater and potable drinkable a sports drink kind of product could be made that way as well and just to add to that this is actually phase one of the forward
osmosis bag so we're using this technology demonstration to demonstrate the technology of the membrane and microgravity so we have already been accepted as a sdt 0 or X dto 45 phase 2 so that we would be able to take more samples at hourly interval and get a better curve of the flux rate as the water passes through the membrane so this is pretty much just demonstrating the technology of the membrane for this particular flight in the key point there is that it's necessary to elevate the technology
readiness level of this technology and
demonstrate that it functions in a
microgravity environment and that's
really the main purpose of what we're
trying to do and once we demonstrate
that it does indeed function in
microgravity as it does on earth then
the program can take it and plan on
using this technology in the future
endeavors okay can you have question
describe a little bit of the shuttle
astronauts will do this not the ISS
astronauts and when you do bring it up
as an emergency situation yeah that's
what I was wondering how many bags would
You bring up and has anything like this been flown before thank you I'll take the first couple questions yes this is a sortie mission so a sortie payload meaning that it will be launched in return from on the shuttle it will not cross over onto the space station so we have one of the U.S. crew members actually Rex Walheim will be conducting the experiment two days before they're returning and what is the second question has any been thing then flown like this before and how many units would you bring up to the ISS so no this
has not been flown before and the number

that would be brought up really that's a

programmatic decision but if you think

of it we spend quite a bit of money

bringing water up to the International

Space Station there are contingency

water container bags that are brought up

they contain about forty three liters of

water they're stowed they have a certain

lifetime after which they are no longer

rated for drinking these could be used

to recertify those expired waters

a potable drink again it doesn't produce

water but it produces a sports drink
kind of a product and as an example for

the post splashdown I believe each astronaut gets two gallons of water as

you're waiting for a boat to come and

pick them up and so if you're able to

just send each a pouch / astronaut

you're reducing mass and volume that's

going to be on the the orbiter when

they're returning and each bag is able

to be used up to 10 times so you're able

to recycle the bag up to 10 times so let

me elaborate a little bit so you saw

that each bag can purify let's say a

liter of water over the course of four
to six hours over the course of one day

that would be four uses and most for

most applications the bags could be used

up to 10 days in duration so ten days

you know using the maximum rate four

times a day would be 40 times it's all

dependent on what you're introducing

into them but up to 40 times the bags

can be used and if you think of that

that's 40 liters of drinkable solution

40 litre is about four Wieters to a

gallon that's about 10 gallons each

gallon of water is about a little bit

more than eight pounds so and if you

think about ten thousand dollars per
pound for launch costs that's a conservative figure there could be quite a bit of a savings one last question can they be built larger yes this is really a you know an individual size unit you know develop mostly for you know commercial applications right here.

Jim Siegel from the celebration independent newspaper again I think you mentioned that that is commercially available now and so two questions one if someone wanted to buy that today how would they do it is there a website or something like that and secondly the
forward osmosis bag I assume you've done

some testing here on earth before you're
doing this so has has anyone actually
drunk from drunk the liquid that came
out of that here on earth and are they
still living well to answer your first
question yes these are available as are
the CPAC and the hydro pack the hydro
pack has actually been used for
hurricane and earthquake relief
hydration technologies has sent these
over to haiti for for earthquake relief
and yes their website is HTI water calm
tea l water calm and you're able to
purchase all of their products on their website and your follow-up question yes

in order to manifest a payload we have to go through a whole payload integration process where we first we verify the science and using a science verification test where we kind of use a prototype component of the hardware but just to verify that the science would work and we do it in our orbiter environmental simulator chamber which actually follows one of the temperature profiles of the shuttle and then once we verify that the science works then we
move on and prepare for a payload

verification test which is where we actually use the flight hardware and the science to verify that everything will work properly and no nobody has to my knowledge has a drink anything yet but we are able to produce the nutrients I believe you can change nutrients and osmotic concentrate to fit any kind of nutrient profile that the crew members would need to nourish themselves

FDA approved but we did have some Japanese a TV team from Japan and they drank it a little bit we advised them not to but they did and and I saw a guy
outside you know he's still walking around yeah yeah yeah and they said it just tasted like a sweet gatorade sports drink and the commercial product if you were to purchase it also the drinkable product would be a lemon lime orange you can get any flavor that you want pretty much and it just tastes like a sweet sports drink but as part of our verification pre flight tests we did verify we introduced for instance known concentrations of bacteria on the dirty side and we confirm the manufacturer's specifications that there's 99.9999
percent rejection of the bacteria by the semi permeable membrane. There's also 99.99 percent rejection of viral particles. Similar levels for parasites and cysts of different types. The great thing about forward osmosis is that you don't need any electrical, mechanical, or kind of equipment to use it. The membrane works on its own and it's low mass, low volume, no power required, so it's a very ideal spaceflight application. Okay, we have a question right here. Sure, Pete Crow st. our productions in non Studio City California. Two questions here. One
we visit briefly here I believe you said

about 80% you can recover and then the

second question is on will further

testing be necessary or you expect that

this will be ready to fly on a

operational basis following the end of

sts-135 we don't think that there's an

immediate need for this on station the

program could fly them as is the flight

rated versions what we're trying to do

is to get follow-up flights to further

find the the characteristics of the bag

in a more precise way we view this first

flight is really getting over the
barrier of elevating the technology

00:22:03,569 --> 00:22:09,119
relevance level and to demonstrate that

00:22:06,180 --> 00:22:10,650
it works in microgravity but we could do

00:22:09,119 --> 00:22:13,739
quite a bit more in terms of studying

00:22:10,650 --> 00:22:18,960
the rates in a more scientifically

00:22:13,740 --> 00:22:21,480
rigorous fashion but there could be some

00:22:18,960 --> 00:22:24,960
that are flown at any time after this

00:22:21,480 --> 00:22:28,910
demonstration we're not aware of the

00:22:24,960 --> 00:22:28,910
program wanting to do that at this time

00:22:29,420 --> 00:22:33,500
are there any further questions

00:22:50,599 --> 00:22:56,000
well just to further go on about the

00:22:54,169 --> 00:22:59,330
hurt hurricane relief i actually have

00:22:56,000 --> 00:23:02,119
their HTI's product the hydro pack and

00:22:59,329 --> 00:23:05,058
my hurricane relief package at home and

00:23:02,119 --> 00:23:06,739
it's very it's similar to a Capri Sun
what the sugar is already pre-loaded into the pouch and you can just have a bucket of rain runoff or any kind of runoff water and stick the pouch in the bucket and after about four to six hours of activation then you can just stick a straw in it and drink it like a Capri Sun so it is available for anybody to use for any kind of hurricane relief or a quick relief for everyday use actually well it may not be the way that you would want to go for the primary generation of water there are alternative implementations of the
technology that aren't so much bags with in a bag but pumping devices that you can pump water through it and the water that comes out is cleaner than then what was introduced so there's other implementations that I think would be more relevant for that but but based on the same technology and hydration technologies actually does do a lot of work in third-world countries they go over and they actually try to implement some water recycling systems using these the forward osmosis technology so that they do currently go overseas into third
world countries and help them implement

into little cities and villages but you

can find further information on their

website but then we would have a follow

up front

Jim Siegel again from the celebration

independent newspaper my readers are

interested in the spin-off benefits of

space exploration on to what's going on

on earth today so in this case we have

existing earthbound technology being

applied to space so can you see some

learnings coming back to earth bound

applications from the experiment that's

applications from the experiment that's
going to be done here on Atlantis

00:25:06,480 --> 00:25:12,130
allergy refining the technology or

00:25:08,829 --> 00:25:13,720
something like that well there has been

00:25:12,130 --> 00:25:16,900
quite a bit of research that's been done

00:25:13,720 --> 00:25:19,660
on earth that has gone into optimizing

00:25:16,900 --> 00:25:22,240
the design for Earth based applications

00:25:19,660 --> 00:25:23,980
it's conceivable that we may learn

00:25:22,240 --> 00:25:27,069
something and part of the reason we're

00:25:23,980 --> 00:25:29,980
flying is to see how does the membrane

00:25:27,069 --> 00:25:34,419
operate in microgravity without

00:25:29,980 --> 00:25:38,410
convection based buoyancy without some

00:25:34,420 --> 00:25:41,200
physical concentration mechanisms that

00:25:38,410 --> 00:25:43,080
are occurring on earth or decreased

00:25:41,200 --> 00:25:46,090
level so it's possible that the

00:25:43,079 --> 00:25:48,490
fundamental knowledge it's generated by
this space flight experiment which will be done in microgravity as opposed on 1g might produce some enlightenment that could be used in earth based applications in the future ok any further questions one more here I can't go spaceflight magazine can you talk about what's the total weight it seems seems pretty light and is this possibly even tested in the Indies short term suborbital flights at all where you get microgravity for a few minutes so I believe each of these bags is on the order of 300 grams ok so relatively
lightweight the problem with doing the

the earth base microgravity analogs and

there's two of those that I think you're

referring to one is the parabolic

flight series in which you get on the

order of 20-25 seconds of microgravity

interspersed with 2g and one

gee that would be very difficult because

it's not long enough to get significant

results the other category which is the

the new emerging suborbital industry

that we're all looking forward to there

you can get somewhere between our other

promises to get somewhere between two
and five minutes of microgravity it's still probably short for this

implementation but usually what you do is you design a different sized bag or whatever your hardware is that you're testing so that you could get significant results so it wouldn't be these sized bags but we could scale them down so that we could get some interesting results from those implementations system the whole payload weighs approximately six point three kilos so about 12 14 pounds and it's going to fill up approximately
two-thirds of a mid dec locker so we

00:27:52,490 --> 00:27:58,308
will be sharing with another paler

00:27:54,019 --> 00:28:01,009
that's flying up cube lab okay well this

00:27:58,308 --> 00:28:03,678
will conclude our demonstration and our

00:28:01,009 --> 00:28:05,720
next televised event will be the NASA

00:28:03,679 --> 00:28:08,720
Aeronautics research update at

00:28:05,720 --> 00:28:11,150
eight-fifteen a.m. tomorrow morning for

00:28:08,720 --> 00:28:16,640
more information on the sts-135 mission

00:28:11,150 --> 00:28:19,870
and crew go to ww NASA gov / shuttle

00:28:16,640 --> 00:28:19,870
thank you for joining us