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ored feces (diarrhea) point to a gastrointestinal tract insult. To follow is a more detailed look at each of the suspect factors that can contribute to the problem of wet pits/wet droppings, and stained shells.

#### House Factors

Physical factors in the design, placement and function of the house and equipment can result in excessive moisture in the manure pit. Excess water can be absorbed into the manure piles making them soggy and "soupy" in consistency.

Instead of the droppings piling or "coning" in relatively dry hills under the cage rows, the manure levels off and settles across the rows. In these cases, house orientation, pit design, ground water runoff, wall leakage and pit ventilation should be checked.

In periods of high rainfall, such as occurred in Pennsylvania in 1996, ground water accumulation can be more of a problem than anticipated. Water from equipment, commonly originating from leaking waterers or water lines, can add appreciable amounts of moisture to the pit. Arrangement of cages and dropping guards (curtains or scraping boards) impacts on how the excreted manure enters the pit and how much drying of the dropping occurs.

In the specific case of increased stained eggs, slope of cage floors and possible obstructions between the cage floor and egg belt should be evaluated. The type and placement of waterers (nipples, cups) impact on the amount of water leaked or splashed out and wasted. Ventilation intakes and fans must be set to optimize air quality and prevent excessive moisture build up in the house.

Proper temperature control including adequate house insulation also factors into decreasing the formation of condensation on surfaces within the house.

#### Feed And Water Factors

Feed formulation should always be checked carefully as certain ingredients may cause "osmotic" diarrhea. Excessive salt in the ration is a common cause of osmotic diarrhea and increased water intake. Certain types of bakery by-products may be hidden sources of excess salt.

Salt levels in the water should also be checked. Water meters should be monitored to determine if intake is normal for the given environmental temperature and humidity, always taking into account that it is important for birds to drink more in order to avoid overheating in hot, humid conditions.

Certain mycotoxins that may be contaminating feed can cause wet droppings. Ochratoxin, oosporein, and citrinin are documented examples of this phenomenon. Ochratoxin's main effect is damage to the kidneys. Urate consistency is altered and wet, sticky urates can result in increased eggshell stains. Oosporein also damages kidneys, and end-stage renal disease may result.

Birds often develop gout and urate consistency may change. Citrinin's primary effect is a marked increase in water consumption by the birds which almost immediate-

ly results in very watery droppings.

#### Genetic Factors

Some strains of chickens have a tendency toward wetter droppings than others. Some naturally have a softer fecal portion, while others have more watery urates.

The ability to concentrate uric acid and reabsorb water from the intestinal/cecal content can vary considerably. Some strains of birds tend to drink more than others, and the extra water intake flushes through the kidneys and results in watery droppings.

Behaviorally, some birds tend to "play" with or splash in waterers, causing more spillage than would occur with less aggressive drinkers or more passive birds.

#### Disease Factors

Finally, urinary tract or gastrointestinal tract disease can alter the final consistency of the dropping. Commercial layers experience many insults to their renal system, which can cause kidney damage. Particularly, the condition called "urolithiasis" (urate stone formation), is a relatively common ailment.

Causes of kidney damage/urolithiasis are high relative calcium in the pre-lay ration, alkaline ration, water deprivation and previous infection by nephrotropic strains of infectious bronchitis virus. Genetic strain of bird has also been implicated in the predisposition to develop urolithiasis. As previously noted, certain mycotoxins can also cause end-stage renal disease. In many flocks with significant kidney disease, egg production drops and increased mortality eclipse any complaints of changes in dropping consistency, but these problems may be concurrent.

Enteritis, which is defined in general terms as any inflammation in part or all of the intestinal tract, can result in diarrhea. Enteric bacteria, viruses, and parasites can cause different forms of enteritis. Bacteria such as *E. coli* and *Salmonella* sp. likely cause enteritis in chickens, but these conditions are not as well defined as they are in mammals such as cattle and swine. Certain anaerobic bacteria, particularly *Clostridium* Sp., can overgrow in the intestine and cause ulcerative or necrotic enteritis.

Many enteric viruses including reovirus, rotavirus, etc. can cause intestinal pathology particularly in young birds. Protozoal parasites such as coccidia and cryptosporidia and helminth parasites including roundworms and tapeworms also contribute to GI tract dysfunction. All of these pathogens may contribute to wet feces, although most are considered uncommon problems in adult caged layers. Biogenic amines, mycotoxins or other irritating compounds in feed also cause enteric disease that can result in diarrhea. Again, these causes are relatively uncommon.

A condition called "cecal spirochetosis" has been diagnosed recently at the Penn State University Animal Diagnostic Laboratory in chickens from several layer flocks presenting dirty vents, diarrhea and/or increased staining of eggshells. In this condition, heavy numbers of spirochete-type bacter-

ia (motile, spiral-shaped flexible rods) appear to be colonizing the mucosal surface and crypts of the cecal lining. Some of these bacteria appear to be invading the deeper tissues of the cecae, and mild to moderate inflammation is present.

With unaided vision, the cecae often do not appear abnormal, although the cecal content of some birds may be watery or foamy. Because a major function of the cecae is reabsorption of water from the intestinal tract contents, any pathology in this specialized portion of the lower tract can result in watery feces.

The diagnosis of this condition is made by microscopic examination of specially stained cecal lining smears and fixed cecal tissue. Special bacteriologic cultures of the cecae are also taken to grow the spirochete on artificial media. Culture of the organism is slow (5-6 days) and the organism is difficult to sub-culture.

At Penn State, further characterization of the spirochete by biochemical and electron microscopy

techniques is under way. To date, the bacterium has not been speciated, but many of its characteristics are similar to bacteria in the genus *Serpulina*.

One species in this genus — *Serpulina hyodysenteria* — is the causative agent of swine dysentery, a diarrhetic disease of pigs. Although normal cecal flora of chickens likely includes one or more species of spirochete bacteria, it appears that the specific overgrowing spirochete associated with cecal spirochetosis can be a pathogen in certain instances.

In recent years, published case reports originating from Iowa and Ohio have described cecal spirochetes associated with diarrhea/dirty eggshells in layers. Previously, reports of similar spirochete-associated conditions had appeared in the European literature. Laboratory testing in Iowa has shown that cecal spirochete isolates from chickens and rheas are consistently sensitive to several antibacterial drugs including carbadox, lincomycin, tiamulin,

and bacitracin. Of these drugs, only bacitracin (low level) is approved for use in commercial egg layers. It is uncertain if the allowable level would be effective against layer cecal spirochetosis.

Antibacterial therapy followed by probiotics/normal gut flora competitive exclusion products would be a treatment regimen worthy of testing.

Many questions remain about the source, mode of transmission and spread of the bacteria, its role as a pathogen or co-pathogen, and effective treatment and control of the condition in layer chickens. More investigations into flocks with symptoms of diarrhea are necessary to determine the incidence of the condition.

Either cecal spirochetosis is a fairly uncommon condition, or it is present with significant frequency but rarely diagnosed in routine diagnostic work-ups. Cecal spirochetosis should be considered as a differential diagnosis in cases of diarrhea and eggshell staining in layers.

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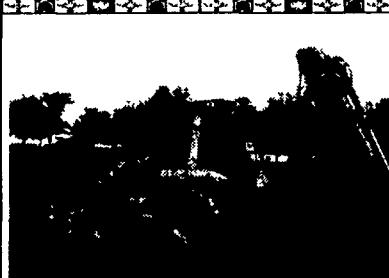
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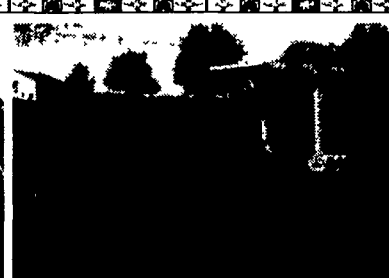
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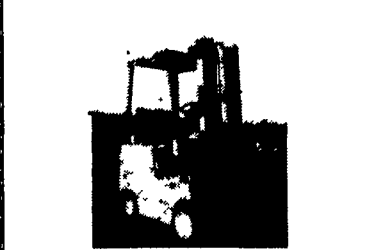
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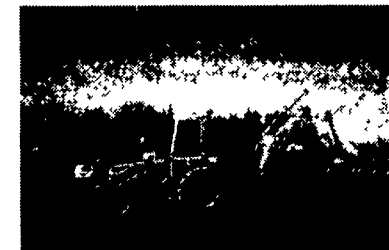
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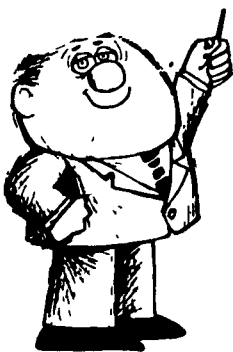
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